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ABSTRACT

Integrated Pest Management (IPM) is a decision-making approach to pest control that has been used successfully on farms, city parks, offices, homes, and schools. IPM programs help individuals decide when treatments are necessary, where treatment would be most helpful, and what combinations of tactics would be most effective, safe, and inexpensive to adequately suppress the pests. The basic strategy of IPM involves modifying the environment so it is not capable of supporting a large pest population. This guide is designed for use by school system administrators in setting up an IPM program to control cockroaches throughout the school system. The program operates within the school hierarchy using four primary workgroups: pest control service operators; school principals; maintenance service personnel; and food service personnel. The first part of the guide, presenting the basics of a school IPM program, includes sections on: program initiation; five basic components of a cockroach control program; workshop composition/responsibilities; recordkeeping forms; and details of program components. The second part provides more detailed descriptions of the program's components and a brief discussion of basic cockroach biology and behavior. The final part describes elementary-level teaching packets available to school systems interested in including alternative pest management techniques in their curricula. (JN)

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SAFE COCKROACH CONTROL

A Guide to Setting Up an Integrated Pest Management Program Within a School System

by

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JMI's Urban Integrated Pest Management Program has developed numerous pest management plans for school districts, city and county agencies, state agencies, and the National Park Service.

Other JMI Program Areas are Wildland Resources, Water and Arid Land Resources, and the Socio-Economic Impacts of Alaskan Development.

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INTRODUCTION

What is IPM?

Integrated Pest Management (IPM) is a decision-making approach to pest control that has been used successfully on farms and in city parks, in offices, homes and schools. An IPM program helps you decide when treatments are necessary, where the treatments would be most helpful, and what combination of tactics would be most effective/safe/inexpensive to adequately suppress the pests.

How Does It Work?

The basic strategy of Integrated Pest Management is the modification of the environment so that it is not capable of supporting a large pest population. When food, water and preferred harborage are removed, a limit is placed on the number of cockroaches that can exist in a particular location. Additional techniques and tools can be used to prevent entry of cockroaches into the school building and to suppress large cockroach populations already living there. These activities require the interaction and cooperation of many different members of the school system. With IPM, pest control is no longer just the work of the Pest Control Operators.

Why Not Use Routine Pesticide Treatments?

Conventional insecticides will usually reduce a cockroach population — but only temporarily. Often individual cockroaches manage to avoid or resist the poison. If the environment is favorable, these individuals quickly repopulate. Even if no individuals escape, it is only a matter of time before new cockroaches are reintroduced into the school from the outside. These too quickly multiply and soon reach numbers as great as before chemical treatment took place. This can result in the institutionalization of a never-ending cycle: 1) an unacceptable cockroach population level, 2) insecticide application, 3) temporary cockroach population reduction, with 4) the return to an unacceptable cockroach population level. In addition to repeated cockroach outbreaks, this cycle entails repeated exposure to toxic insecticides — with

hidden health hazards (and potential legal liability) for the applicators as well as for the teachers, staff and students.

This guide is designed for use by an administrator of the school system. It will help this person set up an IPM program to control cockroaches throughout the school system. As demonstrated in other large institutional buildings (Todaro, 1982) and individual schools (Cowles, 1983), IPM can protect a school system from pesticide exposure and liability, the high cost of routine chemical treatments—and cockroaches!

Guide Contents

This manual is a step-by-step guide to help the administrator institute an IPM program for cockroach control throughout an entire school system. The program operates within the school hierarchy, using four primary workgroups, each of which plays an important role:

- pest control service operators,
- school principals,
- maintenance service personnel, and
- food service personnel.

The first part of the manual presents the basics of a school IPM program, including sections on:

- 1) Program Initiation,
- 2) Five Basic Components of a Cockroach Control Program,
- 3) Workgroup Composition and Responsibilities,
- 4) Recordkeeping Forms, and
- 5) Details of Program Components.

Administrative personnel involved in the development of this program should be familiar with the entire manual. Pages of the manual that describe the responsibilities of each workgroup can be duplicated and distributed to members of each workgroup to acquaint them with their role in the program.

The "In-Depth Information" section provides more detailed descriptions of the program's components as well as a brief look at basic cockroach biology and behavior.

The final section describes elementary-level teaching packets available to school systems interested in including alternative pest management techniques in their curricula. An order form for obtaining these materials and more information on IPM is provided.

Getting the Program Off the Ground

The system-wide program is initiated and coordinated by an "Administrative Coordinator." This person could be the individual formerly responsible for hiring/supervising the in-house or contracted pest control company. Since the program's success depends on the cooperation of many different members of the school system, the Administrative Coordinator's main responsibility is one of coordination. He or she explains the program to workgroup supervisors, requests their enthusiastic participation, and then plays a leadership role in resolving any problems or conflicts that arise.

The school principal oversees all program activities in his or her school. The principal reports problems and chemical treatments that occur to the Administrative Coordinator, who then meets with the supervisors of the workgroups involved in the problem to direct its resolution.

A successful program will eventually become an accepted part of the school system's routine. In the beginning, however, some resistance to redefining job descriptions as broadly as this program requires may be encountered. The following suggestions may help ease program development through any initial difficulties.

- 1) Make sure employees are aware of the new program's potential benefits.

When operating smoothly, this program will:

- * reduce the number of pests actually living in the schools
- * reduce employee exposure to toxic chemicals
- * save the school system money (by removing the need to purchase costly pesticides)

- 2) Make sure that all employees understand how the new program works.

The supervisor of each workgroup is responsible for explaining the program to his/her employees. Materials stressing important points can be duplicated and distributed. Each supervisor should also consider hosting problem-solving sessions within or between workgroups if the need arises.

- 3) Modify pest control contract (and/or other Job Descriptions) to support the new program.

Many pest control contracts specify routine pesticide treatments and/or penalize pest control contractors that don't provide routine applications of pesticide. It is important to review (and, if necessary, rewrite) these contracts to ensure that they require the pest control contractor to provide the low toxic pest management outlined in this guide. It may also be necessary to revise the formal Job Descriptions of in-house work groups (e.g., in-house pest control, maintenance workers, etc.) to both permit and require their participation in this program. This should not be difficult once management and workers are aware of the benefits of a low toxic pest control program.

- 4) Be aware that your IPM program makes your school system a "front runner." Congratulate yourselves!

The rising cost of petroleum-based pesticides and the growing "toxin consciousness" of the American consumer will eventually force all school systems to adopt environmentally-sound pest management practices. By dealing with these issues now, you will be developing a pest control program that will not only protect you from cockroaches, but will protect you from the danger and expense of toxic pesticides as well.

What is a "Successful" Program?

The Administrative Coordinator should set realistic measures of success for the program. Permanent eradication of cockroaches is extremely difficult in a setting combining food distribution, waste disposal, and much public

traffic. However, roaches can be kept below an "injury level" -- the level at which they are embarrassing or troublesome -- using the techniques outlined here. A program's success should be measured in part by the level of cooperation among everyone involved and the amount of cockroach habitat modification each seems willing to undertake. Another important criterion for success is the extent to which toxic treatments are eliminated and only the least toxic pesticide available (boric acid) is used. Because cockroach control requires constant vigilance, a final measure of success should be the extent to which sanitation procedures necessary to reduce cockroach habitat become part of all school routines.

Modifying the Program for Non-School Settings

Although this manual addresses cockroach control from a school system's point of view, it can be used by other institutional buildings and systems, both large and small. Non-school building managers and administrators may:

- 1) Change workgroup and supervisory titles and functions as defined in this manual to fit the actual situation.

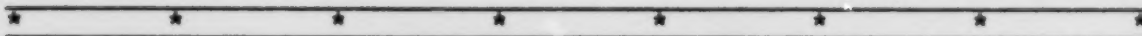
For instance, in a setting where several large apartment buildings are included in the pest control program, the "Administrative Coordinator" might be the person who is normally responsible for administering the entire complex. The "School Principals" might be the managers of individual apartment buildings, and tenants might play the roles of "Food Service Personnel" and "Teaching Staff." In an office building, office workers might be the equivalent of the "Teaching Staff."

- 2) Make a special effort to control food consumed in non-food handling areas.

Whether or not an office building houses a cafeteria or other food handling area, a significant amount of food passes through the building each day. Workers need to be encouraged to keep desks, lockers, lounges and coffee-serving areas clean, with food and food wastes stored in tightly-lidded containers.

- 3) Involve residents, tenants, patients or other non-employees residing in the building(s) in the program.

A program to control cockroaches will not be successful unless all food handlers, waste handlers and building repair personnel are working together to remove the cockroach food, water and habitat identified by the pest control operator. In an apartment setting, this may require rewarding tenants that properly manage their food and food wastes (see Todaro, 1982, for one approach to this problem). However, the extra time and energy required of building managers and tenants will be rewarded by the benefits of lowered pest control costs for the management, reduced exposure to toxic pesticides for the tenants, and fewer cockroaches for everyone.



See Page:

In-Depth Information

Why Should Cockroaches Be Controlled?	1-A
Pest Cockroaches: A Management Summary	3-A
Cockroach Program Update (Todaro, 1982).	5-A
School Pest Management Program Report (Cowles, 1983)	7-A
Contract Specifications: The Weak Link in the Transition to Cockroach IPM (Olkowski, et al., 1982)	13-A

PROGRAM INITIATION

1. An Administrative Coordinator of the system-wide IPM program is chosen or designated. This person becomes familiar with the purposes, processes, and techniques of the IPM program.
2. The Administrative Coordinator calls a meeting with the Supervisors of the four primary workgroups:
 - Pest Control Operators (PCO)
The Supervisor of this workgroup is a representative of the company that supplies pest control services to the school system.
 - Principals (or representatives)
Each school in the system should be represented by either its principal or an appointed representative (referred to as the Office Facilitator). The principal (or Office Facilitator) is considered the workgroup supervisor for both the teaching staff and the administrative staff of the school.
 - Maintenance Personnel
The Supervisor of this workgroup is the Chief of Maintenance for the system or district.
 - Food Service Personnel
The Supervisor of this workgroup is the Chief of Food Services.
3. The Administrative Coordinator distributes necessary forms and background information to each workgroup Supervisor. He or she explains the benefits and objectives of the program and outlines the responsibilities of each workgroup. Potential problems are discussed.
4. Each workgroup Supervisor then communicates this information to the members of his or her workgroup.

FIVE BASIC COMPONENTS OF A COCKROACH CONTROL PROGRAM

1. MONITORING

Monitoring guides the entire program. It includes:

- a survey of each school to determine how severe the roach infestation is, where it is concentrated, and what habitat modifications are needed
- placement and regular examination of cockroach traps to help determine needed treatment action and to evaluate the effectiveness of previous treatments.

2. HABITAT MANAGEMENT

Habitat management reduces pests by changing the environment in which they live. It involves reducing three life supports:

- food (by improving sanitation in food handling areas and classrooms)
- water (by reducing or eliminating all sources of moisture)
- harborage (by reducing places for roaches to live and breed).

3. DIRECT SUPPRESSION

Direct suppression reduces pests directly, using the least hazardous pesticide available.

4. RECORDKEEPING

Recordkeeping keeps track of all records pertaining to the program. It provides:

- easily-accessible data on all aspects of the pest control program
- a basis for program evaluation.

5. EVALUATION

Evaluation, which is based on monitoring and feedback on the program from each Workgroup, assesses the program in each school and for the whole system. It involves:

- periodic review of the program within the school system
- an analysis of all treatments and their effects
- an investigation of any complaints or illnesses possibly related to chemical treatments.

WORKGROUP COMPOSITION AND RESPONSIBILITIES

The Administrative Coordinator workgroup consists of a single person who organizes the program for the entire school system. He or she:

- gets program off ground
- clarifies assignments and responsibilities among Workgroups
- hires pest control company (if outside company is used)
- establishes central records for system
- reviews records and program functioning.

The Pest Control Operator (PCO) workgroup is composed of all PCO employees of the company that supplies pest control services to the school system. One PCO may be assigned to each school, or a PCO may be assigned to several schools, or several PCOs of a company may float among the schools, drawing upon the schools' monitoring records for continuity. The supervisor of the PCO workgroup is the PCO selected as the company representative. He or she is responsible for the actions of the other PCO employees and for making certain they understand the program.

Within a school the Pest Control Operator monitors, makes recommendations for habitat modifications and applies direct suppression techniques. He or she:

- obtains Trap Monitoring Forms, Cockroach Control Work Summaries, and Chemical Use Reports from Office Facilitator
- performs initial school survey
- inspects locations where cockroach sightings have been reported to Office Facilitator
- recommends maintenance and food handling changes to reduce cockroach habitat; records recommendations on Cockroach Control Work Summary
- places cockroach traps in locations favorable to roach populations; records trap locations and subsequent cockroach numbers caught on Trap Monitoring Form
- applies least-hazardous chemical if necessary; records on Chemical Use Report
- evaluates results of previous chemical treatments; records on Chemical Use Report
- leaves completed forms with Office Facilitator.

The Principal workgroup has as many members as there are schools in the system. There is no overall supervisor of this workgroup as each principal is responsible for overseeing the program within his or her own school. He or she:

- appoints Office Facilitator for the school
- periodically reviews program in school to see that it is running smoothly and that Cockroach Control Work Orders are being executed

- encourages teachers to include pest education in classroom activities
- instructs administrative staff in pest management program principles
- reports problems to Administrative Coordinator.

The Office Facilitator workgroup also has as many members as there are schools in the system. Each Office Facilitator is under the supervision of the principal for his or her school.

The Office Facilitator serves as the communication channel for the workgroup activities within the school. He or she:

- establishes and maintains Cockroach Binder (a loose-leaf, 3-ring binder) which serves as office pest control filing system
- prepares forms needed by PCO (Trap Monitoring Form, Cockroach Control Work Summary, Chemical Use Report)
- prepares Cockroach Control Work Orders based on recommendations made in Work Summary
- distributes completed forms to appropriate workgroups
- records pest sightings reported by in-school staff on Cockroach Sighting Log kept in Cockroach Binder for PCO review.

The Maintenance Personnel workgroup may exist in two forms. There may be a general maintenance pool that serves specific schools as needed and/or specific maintenance staffs at each school responsible for (part or) all of the maintenance activities within that school. The supervisor of this workgroup, who is directly accountable to the Administrative Coordinator, is the Chief of Maintenance for the entire school system. The Chief is responsible for instructing the heads of maintenance for each school in the activities of the program. In turn, the individual school maintenance heads are responsible for instructing their staffs on the program principles and overseeing work activities necessary for the program's success within their school.

The Maintenance Personnel workgroup eliminates points of roach entry, modifies roach habitat, and reduces harborage, food and water sources. This group:

- receives Cockroach Control Work Orders from Office Facilitator
- caulks cracks and crevices in areas harboring roach populations
- makes other minor structural repairs where needed
- improves waste management
- fixes all pipes, faucets, water heaters, and fountains as soon as leakage is detected
- notifies Chief Maintenance Supervisor if major repairs are needed
- occasionally participates in roach surveys and monitoring
- reports roach sightings to Office Facilitator.

The Food Service Personnel workgroup may also exist in two forms. There may be a general food services staff that prepares meals at a central location for distribution to the individual schools, or there may be fully functional kitchens in each school. The supervisor of the Food Service Workgroup, who is directly responsible to the Administrative Coordinator, is the Chief of Food Services for the entire school system. The Chief is responsible for instructing the heads of food service for each school in the activities of the program. In turn, the individual school food service heads are responsible for instructing their staff on the program principles and overseeing work activities necessary for the program's success.

The Food Service Personnel workgroup modifies the roach habitat in food handling areas and oversees food and waste handling and storage. This group:

- receives Cockroach Control Work Orders from Office Facilitator
- keeps food handling areas and tools clean
- stores food and wastes in tight, pest-resistant containers
- reduces all clutter in food-handling areas
- supervises waste disposal, especially of students and staff
- reports leaking faucets, fountains, pipes, and appliances promptly
- notifies Chief Food Service Supervisor if additional supplies or equipment are needed
- reports roach sightings to Office Facilitator.

The Teaching Staff workgroup is composed of as many units as there are schools in the system. The staff of each school is under the supervision of the principal for that school.

The Teaching Staff teaches proper storage and disposal of classroom food and wastes, supervises students in food and waste handling, and presents educational programs on pest management. This group:

- oversees storage and disposal of food in classrooms
- oversees management of classroom animals' food and wastes
- stores pastes, glue, paints, and other starchy art and science materials in tight-lidded containers
- presents pest management basics to students
- possibly presents educational programs on IPM to parent and community groups
- reports roach sightings to Office Facilitator.

RECORDKEEPING FORMS

1. Trap Monitoring Form

The Trap Monitoring Form, which includes a school floor plan, is used by the PCO to record placement of cockroach traps and the subsequent number of roaches caught at each location.

- Trap Monitoring Form is prepared by Office Facilitator. She/he copies a floor plan of school onto Trap Monitoring Form master provided in this manual. More than one sheet will be needed for a large school.
- Office Facilitator gives copies of prepared form(s) to PCO assigned to school.
- Each Trap Monitoring Form is used for six months. First PCO marks down all trap locations. Then, during next six visits, he/she records number of roaches caught in each trap on back of the form. After this period, trap locations, with any changes, are transferred to a new form which is used for next six months. (See examples at bottom of page.)
- Trap Monitoring Form is given to Office Facilitator at end of each visit to file in Cockroach Binder. Copy is made for PCO records.

Example:

<u>Trap Monitoring Form</u>	
School: <u>Porter Elementary</u>	
Date traps set: <u>9-30-83</u>	Traps set by: <u>John Doe</u>
Detailed description: A floor plan diagram with four labeled areas. 'Bath-room' is on the left, containing traps 1 (F) and 3 (S). 'Rm. 10' is in the upper middle, containing trap 5 (S). 'Rm. 11' is on the right, containing trap 6 (F). 'Main Office' is at the bottom, containing trap 4 (F). Arrows indicate connections between the rooms.	

<u>Log</u>				
Trap #	Date:	Date:	Date:	Date:
	<u>9-30-83</u>	<u>10-30-83</u>	<u>11-30-83</u>	<u> </u>
1	0	2	1	
2	1	1	0	

TRAP MONITORING FORM

School _____ Date traps set: _____

Traps set by (PCO's name): _____

Instructions: Place a circled number on the floor plan to show the location of each cockroach trap. Refer to these numbers when recording the monthly trap catch on the backside of this form.

Action

- 1) Mark trap location
- 2) Record number of roaches trapped during subsequent visit
- 3) Note roach species

Key

Location:

F= floor
S= shelf

Species:

G= German
B= Brown-banded
A= American
O= Oriental

LOG

Instructions: Record the number of cockroaches caught in each trap next to the trap's location number. Repeat this each month that you monitor. When the log is full, begin a new one.

Trap #	Date: _____	Date: _____	Date: _____	Date: _____	Date: _____	Date: _____
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
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2. Cockroach Sighting Log

The Cockroach Sighting Log is a continuous listing of cockroach sightings reported by school personnel to the Office Facilitator. The Log is kept in the Cockroach Binder for review by the PCO during each monthly visit.

3. & 4. Cockroach Control Work Summary and Cockroach Control Work Order

The Cockroach Control Work Summary is used by the PCO to record needed habitat modifications within the school building. The completed Work Summary is translated into Cockroach Control Work Orders by the Office Facilitator.

- Blank Cockroach Control Work Summary forms are made available to PCO by Office Facilitator.
- A Work Summary is filled out by PCO during monthly visit if habitat modifications are needed.
- Completed Work Summary is given to Office Facilitator to file within Cockroach Binder. Copy is made for PCO records.
- Office Facilitator prepares Cockroach Control Work Orders and delivers them to appropriate workgroups.
- Completed Work Orders are signed, dated and returned by workgroup supervisors to Office Facilitator for logging and filing in Cockroach Binder.

COCKROACH SIGHTING LOG

Date	Location of Sighting	Approximate #	Sighting made by	Date Inspected PCO's Initials

COCKROACH CONTROL WORK SUMMARY

School: _____ Issued by (PCO): _____

[illegible]

COCKROACH CONTROL WORK ORDER

For (School): _____ Issued by (PCO) _____ Date: _____

Forwarded to: _____ By: _____ Date: _____

Location of work: _____

Description of work to be performed: _____

Date completed: _____ By: _____

COCKROACH CONTROL WORK ORDER

For (School): _____ Issued by (PCO) _____ Date: _____

Forwarded to: _____ By: _____ Date: _____

Location of work: _____

Description of work to be performed: _____

Date completed: _____ By: _____

5. Chemical Use Report

The Chemical Use Report is used by the PCO to record chemical treatments performed in response to unacceptable cockroach levels that habitat modification has not successfully reduced. The top half of the form is used to record actual treatment information during application. The bottom half of the form, completed during the subsequent visit, is used to evaluate the application.

- Blank Chemical Use Reports are made available to PCO by Office Facilitator.
- Treatment portion of Report is completed by PCO if chemical treatment is made during site visit.
- Report is given to Office Facilitator to file in Cockroach Binder. Copy is made for PCO records.
- Evaluation portion of Chemical Use Report is completed by PCO during visit following chemical treatment.
- Completed Report is returned to Office Facilitator for filing in Cockroach Binder. Copy is made for PCO records.
- Copies of ALL completed Chemical Use Reports are sent by Office Facilitator to Administrative Coordinator.

6. Program Log

The Program Log provides a brief summary of monthly cockroach counts and control activities. It allows for a rapid assessment of the school program's effectiveness by displaying the changes in the total number of:

- Traps set out
- Cockroaches trapped
- Rooms for which habitat modifications were recommended
- Rooms in which chemical treatment was used.

After each monthly PCO visit, the Log should be filled out by either the PCO or the Office Facilitator.

CHEMICAL USE REPORT

TREATMENT DATE: _____ SCHOOL NAME: _____

Operator's name: _____

PCO Company name (if applicable): _____

Phone # where Operator can be reached: _____

Chemical's Brand name: _____ Amount used: _____

Name of active ingredient: _____ % in formulation: _____ %

Concentration: _____ % Form (e.g., wettable powder, dust, etc.): _____

If Boric Acid was not used, please explain why.

Location of chemical treatment:

Room number _____	Area of room _____
Room number _____	Area of room _____
Room number _____	Area of room _____
Room number _____	Area of room _____

How many traps are set in this room/area? _____

★ ★ ★ ★ ★ ★ ★ ★

EVALUATION DATE: _____

How many roaches (and of which species) were caught in this room/area?

3 months preceding treatment:	_____
2 months preceding treatment:	_____
1 month preceding treatment:	_____
1 month <u>following</u> treatment:	_____

If habitat modification recommendations were made for this room/area, were these, to the best of your knowledge, acted upon?

If no habitat modification recommendations were made, please explain.

What changes do you recommend at this time to reduce pests in this room/area without further use of pesticides? Are these noted on the current Cockroach Control Work Summary?

COMMENTS:

SIGNATURE: _____

PROGRAM LOG

SCHOOL _____ Year _____

DATE OF SITE VISIT:
(Month-day)

	9-__	10-__	11-__	12-__	1-__	2-__	3-__	4-__	5-__	6-__	7-__	8-__
Total Number of Traps Counted in Building												
Total Number of Cock- roaches Trapped in Building												
Number of Rooms for which Habitat Modifications were Recommended												
Number of Rooms in which Chemical Use Occurred												
Filled in by:												
Date:												

DETAILS OF PROGRAM COMPONENTS

1. MONITORING

The purpose of monitoring is to:

- identify the pest, its population size and location
- identify site characteristics favorable to the pest
- make treatment recommendations
- evaluate previous treatments.

Monitoring is the responsibility of the Pest Control Operator (PCO) who provides pest control services to the school. He or she may be an outside contractor or an employee of the school district.

FIRST SCHOOL VISIT: Suggested Procedure

1. Obtain all needed forms from Office Facilitator.
2. Inspect locations listed on Cockroach Sighting Log.
3. Place traps in locations favorable to cockroach populations.
4. Record trap locations on Trap Monitoring Form.
5. Record needed habitat modification on Cockroach Control Work Summary.
6. Make copies of forms for PCO records.
7. Leave completed forms with Office Facilitator.

SUBSEQUENT MONTHLY VISITS: Suggested Procedure

1. Obtain needed forms and Cockroach Binder from Office Facilitator.
2. Inspect new listings on Cockroach Sighting Log.
3. Inspect all roach traps, noting numbers of roaches trapped at each location.
4. Record trap catches on Trap Monitoring Form.
5. Replace traps and record any location changes on Trap Monitoring Form.
6. Complete Cockroach Control Work Summary if habitat modifications are needed.

7. Consider chemical treatment with least hazardous material in a room if any one trap contains more than 35 roaches or all traps total more than 70 roaches.
8. Complete the Chemical Use Report if any chemical substances were used in the previous school visit.
9. Make copies of forms for PCO records.
10. Leave completed forms and Cockroach Binder with Office Facilitator.

* * * * *

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2. HABITAT MODIFICATION

FOOD/WASTE MANAGEMENT

The purpose of food/waste management is to make food, a basic life requirement, less available to the roaches.

Food and waste management is the responsibility of both the Food Service and Maintenance workgroups.

Suggested Procedure:

- 1) Steps should be taken to secure food and food waste. Possible solutions to common troublespots include:
 - keep food handling tools and areas clean and dry
 - store food in pest-resistant containers (such as those with snap lids)
 - improve food and paper waste handling and disposal
 - upgrade cleaning procedures
- 2) Make recommended habitat modifications per Cockroach Control Work Order received from Office Facilitator.
- 3) Notify Central Food Services Office or Maintenance Office if additional materials or assistance are needed.
- 4) Report roach sightings to Office Facilitator.

WATER MANAGEMENT

The purpose of water management is to make this basic life requirement less available to pests.

Water management is the responsibility of the Food Service and Maintenance Personnel.

Suggested Procedure:

- 1) Steps should be taken to eliminate or reduce all sources of moisture.
 - wipe up spills promptly
 - report and repair leaking pipes, faucets fountains, refrigerators, water heaters, toilets
 - free clogged drains so water flows properly leaving no standing water
 - keep all storage areas and basement rooms as dry as possible

- 2) Make recommended habitat modifications per Cockroach Control Work Order received from Office Facilitator.
- 3) Notify Central Food Services Office or Maintenance Office if additional materials or assistance are needed.
- 4) Report roach sightings to Office Facilitator.

HARBORAGE MANAGEMENT

The purpose of harborage management is to reduce the living places available to pests. Cockroaches breed in narrow cracks, with a strong preference for areas that are warm and moist. Patching the cracks and holes will reduce the amount of habitat available to the roaches — an important factor in controlling the population.

Harborage management is the responsibility of the Maintenance Personnel work-group.

Suggested Procedure:

- 1) Examine areas where:
 - there is warmth and moisture (e.g., bathrooms)
 - food is prepared, eaten, or stored (e.g., kitchens and cafeterias)
 - food is disposed of (e.g., kitchens, garbage collection areas)
 - roach trap records show a high concentration of roaches
- 2) Remove unnecessary clutter.
- 3) Fill cracks in these areas with caulk, wood putty, plaster, cement, paint, or other appropriate patching compound. (Remember to check near sinks, stoves, toilets, cupboards, etc., and around mirrors, water fixtures, towel dispensers, etc.).
- 4) Patch holes (including vents) that permit pest access to food areas; use patching compound, etc.
- 5) Check containers (including cardboard cartons), furniture, and appliances, etc. entering the school for live cockroaches and/or their egg cases.
- 6) Make recommended habitat modifications per Cockroach Control Work Order received from Office Facilitator.
- 7) Notify Central Maintenance Office if additional materials or assistance are needed.

8) Report roach sightings to Office Facilitator.

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3. DIRECT SUPPRESSION

The purpose of direct suppression is to reduce serious roach populations by treating them with the least-hazardous but still effective chemical. Direct suppression is only effective if it is carried out in conjunction with habitat modification programs.

Direct suppression is the responsibility of the Pest Control Operator (PCO).

Suggested Procedure:

Chemical treatment should be used only in areas where habitat modification alone is not adequate. Insecticidal boric acid dust is recommended as the least-hazardous, most effective chemical treatment for cockroaches.

- 1) Treat each room in which monthly roach count is greater than 35+ per trap or 70+ per room.
- 2) Record all treatment information on top half of Chemical Use Report.
- 3) Record on a Work Summary the physical changes (habitat modifications) that need to be made.
- 4) Make copies for company records and leave forms with Office Facilitator.
- 5) Evaluate chemical treatment during next regular visit to the school.
- 6) Record this evaluation by completing the Chemical Use Report which was filed after previous visit in Cockroach Binder.
- 7) Leave this report with Office Facilitator.
- 8) Make copy for PCO records.

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4. RECORDKEEPING

The purpose of recordkeeping is to keep track of all information about the program so that rational decisions about treatments can be made, the habitat modification recommendations can be reviewed, and the program's effectiveness as a whole can be evaluated.

Recordkeeping for each school in the school system is the responsibility of the Office Facilitator (and/or the school Principal) and, for the entire school system, is the responsibility of the Administrative Coordinator.

Forms have been designed to help keep records. Those included in this manual are:

1. Trap Monitoring Form
2. Cockroach Sighting Log
3. Cockroach Control Work Summary
4. Cockroach Control Work Order
5. Chemical Use Report
6. Program Log

Suggested Procedure:

1) Office Facilitator will:

- Obtain a floor plan of school and transfer it onto a blank Trap Monitoring Form. Make multiple copies for PCO use.
- Maintain a looseleaf, 3-ring "Cockroach Binder" of all forms submitted during program work. This will serve as the office files as well as be used by PCO during regular monthly visits.
- Record cockroach sightings made by school personnel on Cockroach Sighting Log kept in Cockroach Binder.
- Receive completed Trap Monitoring Form from PCO each month. Make necessary copies and file in Binder.
- Receive Cockroach Control Work Summary from PCO if habitat modifications are needed. Make necessary copies and file in Binder.
- Transfer tasks from Work Summary to individual Cockroach Control Work Orders and forward to head of appropriate Workgroup within school.
- Receive and file in Binder signed and dated Cockroach Control Work Orders from workgroups when work has been completed.
- Receive Chemical Use Report from PCO when used. Make necessary copies and file in Binder.

- Forward a copy of completed Chemical Use Report to Administrative Coordinator.
- Transfer summary of program actions to Program Log for quick reference.

2) Administrative Coordinator will:

- Maintain file of all forms sent by school offices in response to chemical treatments.

* * * * *

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5. EVALUATION

The purpose of evaluation is to assess the program in each school as well as for the entire school system. Evaluation may determine that the combined efforts of the workgroups has successfully eliminated large cockroach populations without toxic chemicals. This achievement is a source of pride and satisfaction to all who have participated. Evaluation may also determine that some schools have had greater success than others. If recordkeeping has been thorough, the Administrative Coordinator should be able to pinpoint the areas that need more work.

Evaluation is the responsibility of each School Principal and Office Facilitator, and the Administrative Coordinator.

Suggested Procedure:

1. School Principal will:

- Periodically review filed records to assess program's success within school.
- Seek explanations/corrections from appropriate workgroup if any problems are apparent.
- Investigate any in-school complaints or illnesses possibly related to chemical treatments.

2. Office Facilitator will:

- Report (in writing) to Administrative Coordinator any complaints or illnesses possibly related to chemical treatments.
- Report to Principal any communication or cooperation problems with employees.

3. Administrative Coordinator will:

- Evaluate performance of PCO and overall program functioning at least once every three months.
- Investigate any complaints or illnesses possibly related to chemical treatments.
- Fine-tune coordination of workgroups if evaluation reports indicate problems.

IN-DEPTH INFORMATION

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WHY SHOULD COCKROACHES BE CONTROLLED?

Cockroaches are considered one of the most important structural pests in the United States and other parts of the world. This is due to the health concern of fouled and tainted food that may be contaminated with potentially pathogenic organisms, accentuated by fear and the embarrassment cockroach presence causes. Cockroaches regularly disgorge bits of their partly digested food and drop feces wherever they go. They also discharge a secretion which leaves a persistent and characteristic "cockroach" odor on the food and dishes they touch.

Cockroaches are suspect carriers of human disease because of their preference to inhabit dark, damp, undisturbed areas including toilets, latrines, drains and sewers as well as cabinets, shelves and counters within food preparation areas. Roth and Willis (1960), in The Biotic Associations of Cockroaches, state that cockroaches have been found to harbor, "4 strains of poliomyelitis virus, about 40 species of pathogenic bacteria, the eggs of 7 species of pathogenic helminths, and to serve as intermediate hosts of 12 other species of helminths pathogenic for vertebrates; cockroaches have also been found to carry, on occasion, 3 species of Protozoa that are pathogenic to man, and 2 species of fungi which are sometimes found associated with pathological conditions." Also found on or in cockroaches have been infectious organisms of lesions, infections of the urinary tract and intestine, boils and abscesses, and organisms associated with pus, enteric fever and gastroenteritis, food poisoning, typhoid fever, dysentery, summer diarrhea in children, bubonic plague and leprosy (Cornwell, 1968).

Some people are allergic to cockroaches. In one study, skin tests using extracts of the American cockroach and the oriental cockroach gave 28% positive results out of an unselected group of 114 allergic patients while giving 7.5% positive results among 253 normal persons. There is evidence that in some cases food allergy symptoms may actually be caused by a cockroach allergen with which the food is contaminated (Bernton and Brown, 1964, 1970a,b). The German cockroach produces an allergin within its feces that humans ingest with contaminated food and inhale with house dust.

PEST COCKROACHES: A MANAGEMENT SUMMARY

DAMAGE:

Cockroaches readily feed on human food. They foul what they touch by disgorging bits of partly digested food and dropping feces wherever they go. They also taint everything with a secretion that leaves a persistent and characteristic odor.

They are suspect carriers of disease and have been implicated as carriers of food poisoning bacteria.

Humans may ingest an allergin present in the feces of German cockroaches when eating contaminated food or may inhale dried fecal particles incorporated in house dust. Some apparent food allergies may actually be caused by this allergin and some asthmatic individuals may experience relief when moving from a cockroach infested dwelling to one that is not infested.

SIGNS OF AN INFES- TATION:

A visual sighting is the most frequent indicator of an existing infestation. Consistant sightings almost certainly indicate a problem.

In addition to the insects themselves, brown fecal smears, pellets or droppings will be present as well as egg cases which may be hatched or unhatched, attached to surfaces or loose, usually in undisturbed locations.

MONITORING:

Once it is known that cockroaches are present, traps can be used to identify the species so that management can be directed at the preferred harborage sites. (Oriental roaches are not often found in food and therefore usually do not have to be treated unless considered objectionable.)

Thereafter, traps can be used to monitor the relative numbers of roaches. Traps should be placed along edges and intersections where wall meets wall, floor meets wall, etc.

A survey should be made of food, water and hiding places to give an indication of what relative size roach population the area is capable of supporting.

HABITAT MODIFICA- TION:

Good sanitation, with the reduction of the 3 basic life needs (food, water and harborage), as well as the elimination of points of entry, is critical in cockroach management.

This must include: 1) appropriate cleaning, 2) proper storage in insect-proof containers of food and non-food stocks (animal feeds), 3) insect-proof garbage and refuse storage, 4) repair of all leaks in kitchens and bathrooms, and 5) repair of breaks in walls, floors and ceilings with cracks and crevices sealed by caulking.

Institutions should remove clutter and items that have no use or function in food service and preparation areas.

All remodeling and new construction should be done so that floors, walls and ceilings are easy to clean and have no insect harborages (cracks and crevices).

Dark damp basements and crawl spaces should be kept as dry and light as possible. Fewer cockroaches, specifically Oriental, will be able to survive.

To reduce the possibility of accidental cockroach introduction, shipments of food supplies should be inspected for both the insect and their egg cases before storing. Also new and especially used appliances and furniture should be thoroughly cleaned before moving to an uninfested location.

DIRECT
SUPPRES-
SION:

Traps

Traps can be used to help reduce an infestation. They should be placed along intersections and corners with the broad side down.

Chemical Substances

Boric acid (BA) has been used in successful long-term control of cockroaches under some of the most adverse field conditions such as innercity apartments and restaurants. Its success is attributed to its low repellency and long residual activity. Specific tests have shown control to be as effective 3 months after application as 1 month. BA is a contact insecticide (penetrating the insect's cuticle) and a stomach poison (the insects ingest large amounts when cleaning themselves). It generally takes 7-10 days before the cockroach population is noticeably reduced. BA should be applied as a dust in cracks and crevices and wherever roaches congregate in large numbers. It should be reapplied wherever it is removed (accidentally or otherwise) or if it becomes wet and caked. It is relatively non-toxic to humans and other mammals, and does not give rise to vapors as do the organic insecticides. It should be kept out of the reach of small children, who may eat substantial amounts of almost any powder.

Pyrethrin is a contact poison which is both more toxic and repellent to cockroaches than is BA. It is sometimes used in damp locations where BA would be rendered ineffective.

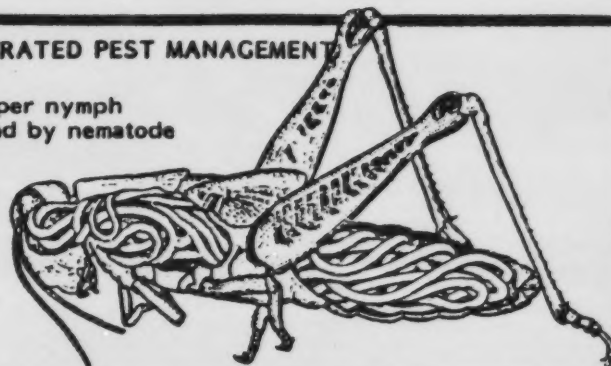
Silica Aerogel a nonabrasive, highly sorptive desiccant dust, kills by causing the cockroach to dry out. It is somewhat repellent to roaches.

Other insecticidal agents, the organophosphate and carbamate based sprays, are even more repellent and have a shorter residual life. Control is usually considered negligible within one month after application. In addition, cockroach populations have developed resistance to a number of these substances.

THE IPM PRACTITIONER

MONITORING THE FIELD OF INTEGRATED PEST MANAGEMENT

grasshopper nymph
parasitized by nematode



Volume IV, No. 4
April, 1982

COCKROACH IPM PROGRAM UPDATE

Widespread cockroach problems in public housing prompted the development of an IPM program for the control of cockroaches, supported by the Housing Authorities of the City of Pittsburgh, Allegheny County and the Allegheny County Health Department. Program components include: bi-monthly surveillance of pest populations and the conditions which breed them; elimination of cockroach breeding sites; evaluation of new pesticides; and education of tenants, management and pest control operators.

Average cockroach populations were reduced by 70 to 95 percent in 300 heavily infested units for six months. Control remained very acceptable in more than half of the units for as long as thirteen months, depending on the pesticide system used. Tenant management of kitchen garbage improved by 60 per-

cent, and general sanitation problems (built-up food, grease and clutter) decreased by 70 percent. Data suggests that improved pest control may provide incentive for improved housekeeping practices. The project reveals that IPM in public housing can limit application of pesticides to once or twice a year with acceptable levels of control, can correct major sanitary and structural causes of pest infestation, can educate and improve the lines of communication between responsible parties and is fairly cost-effective when compared with current methods of pest control in public housing.

(The above is an abstract of the annual report of the described IPM program. For further details, write: William Todaro, Public Health Entomologist, Allegheny County Health Dept., Vector Control Program, 1727 Boulevard of the Allies, Pittsburgh, PA 15219. An earlier stage of this excellent project was reviewed in *The IPM-P*, Vol III(7).

SCHOOL PEST MANAGEMENT PROGRAM
INTERIM REPORT, JUNE 1983¹

By
Kathleen Letcher Cowles²

INTRODUCTION

This paper reports the initial findings of the School Pest Management Project's demonstration program currently being tested in an elementary school in Flint, Michigan. The purpose of the program has been to demonstrate that pests could be adequately controlled without the use of highly toxic pesticide treatments. Data collected from two years of monitoring the school's pest populations indicates that both cockroach and mouse populations have been reduced to manageable levels without the use of organophosphate or anticoagulant pesticides.

The alternative program implemented at Cook Elementary Academy (in September, 1981) is based upon a pest management system known as Integrated Pest Management (IPM). IPM programs typically contain the following components:

1. Monitoring to locate and identify the pest population(s).
2. Removal of pest breeding sites.
3. Improved food/waste handling to remove the pests' food sources.
4. Physical removal of remaining pests, through the selective use of low-hazardous chemical treatments or physical trapping.
5. Limiting access to the building (where possible) by sealing exterior cracks.
6. Educating staff in the importance of proper food and waste management.

¹Entire Report is not included.

²Kathleen Letcher Cowles is Project Coordinator of Grant #83-022 awarded by the Charles Stewart Mott Foundation to the John Muir Institute, Inc. for "Developing Neighborhood Integrated Pest and Waste Management Programs". The John Muir Institute is a non-profit research, education and service organization focusing on natural resources and their management.

Project History

The John Muir Institute (JMI) has long been involved in developing alternatives to toxic pesticide use in urban settings. The School Pest Management Project, funded by a grant from the Charles Stewart Mott Foundation, is an attempt to make some of these techniques available to urban residents through demonstration models and related educational materials.

Flint Demonstration Program

The School Pest Management Project's first task was to develop a pest management program to control the pests in the target elementary school, while reducing the amount of highly toxic pesticides used. The school selected for the demonstration program was Cook Elementary Academy, an older building that had been experiencing noticeable cockroach and mouse problems despite the regular application of conventional pesticides.

Cook Pest History

Prior to the implementation of the pest management program, JMI staff examined pest control records and interviewed members of the Cook staff about the pest problems. Interviews with the principal and custodial staff revealed that cockroaches were commonly seen at the school (especially at night) and that mouse droppings were visible at numerous locations.

During this time, the school was being sprayed monthly with a 1.25% solution of the organophosphate pesticide "diazinon," and rodenticide baits containing "warfarin" were being placed out for the mice. (Although the pest control contract specified that only food handling and locker room areas were to be sprayed, discussions with the head custodian at Cook revealed that most of the building was being treated with pesticide.)

COOK COCKROACH PROGRAM

Monitoring

Monitoring was begun early in the program in an attempt to 1) determine whether a cockroach problem existed; 2) pinpoint the locations where the problem (if any) was most acute; and 3) provide a running tally of the roach populations in various key locations to determine the effect of different treatment strategies on the pest population size.

The monitoring program began with a survey of the custodial, administrative and teaching staffs at the school. Each group was asked to report the location, identity (if possible) and behavior of any pest that they had ever seen at Cook. Non-toxic cockroach traps were set at each of these locations. Traps were also set wherever food, water or habitat suitable to cockroach propagation was available. (The number of traps fluctuated over the monitoring period as they were relocated or removed by custodial staff in the process of cleaning.)

Traps were first set in the school on May 27, 1981, as shown in Graph 1. A subsequent pesticide spraying by the Thumb Pest Company on June 2 was apparently influential in reducing the populations early in June. However, cockroach populations reached an all-time high shortly after that, indicating that this control was temporary at best.

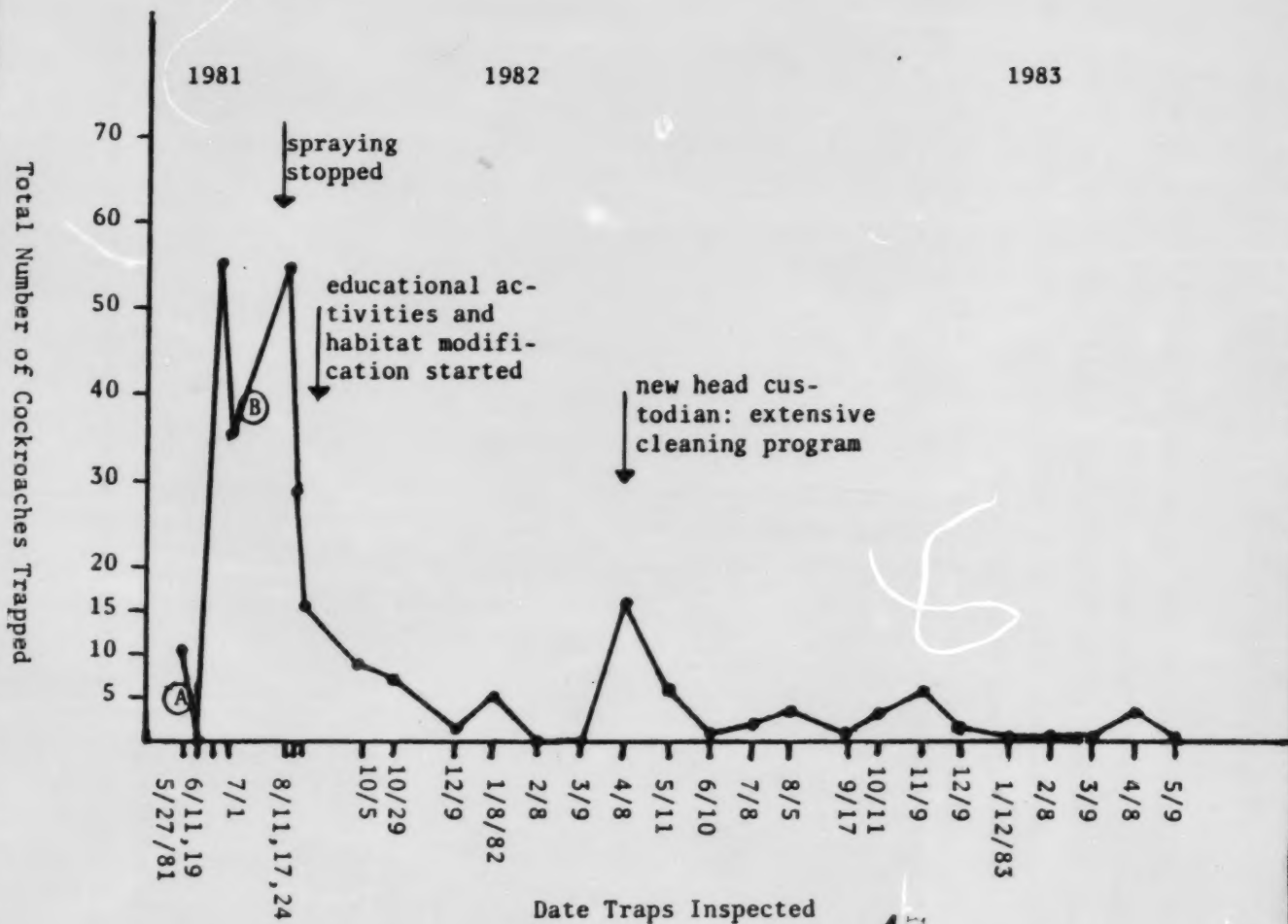
The number of trapped roaches declined over the summer until the custodial staff began an intensive cleaning campaign (in preparation for the resumption of classes) in early July. Cockroach numbers once again shot up, this time apparently unaffected by a pesticide spray treatment on July 7. However, the numbers began to decline in early August — suggesting that the cleaning efforts originally brought the roaches out into the open but eventually reduced the food and breeding habitat available to them.

Implementation of IPM Program

No organic insecticides were sprayed in the school after July 7, 1981. Since monitoring records showed that approximately 88% of the trapped cockroaches were caught in one basement bathroom, intensive habitat modification efforts were directed at that site in early September. These modifications included the repair of a leaky water fountain, patching of several large holes in the walls and floor, and spot treatment with boric acid in cracks in the wooden cabinet structure behind the toilets. The cracks were subsequently sealed. Boric acid is a low-toxic, inorganic compound that has been shown to be relatively safe and effective in controlling cockroaches. It is applied as a fine dust in areas where cockroaches — but not pets or children — will encounter it. It acts both as a contact poison (being absorbed by the cockroach cuticle) and as a stomach poison (being ingested as the roach cleans itself).

ROACH TRAPPING RESULTS

Cook Elementary Academy, Flint, Michigan



- A June 2 pesticide spraying
- B July 7 pesticide spraying

Cockroach IPM Program Results

No organophosphate insecticides have been sprayed in the building since July, 1981. Monitoring data clearly shows an overall decline in the cockroach population at Cook Elementary Academy over the two-year monitoring period. It had been predicted by custodial and teaching personnel that the return of the students in early September would also signal the return of high cockroach numbers. This was not the case. Very few roaches have been sighted or trapped since the inception of the IPM program — and the population in the "renovated" basement bathroom remains negligible. The roach population decline can be attributed to several causes, including cleaning by custodial staff, modifications in the cockroaches' prime breeding habitat to make it less desirable, the use of a boric acid insecticide, and increased staff awareness of the importance of proper waste management.

Contract Specifications: The Weak Link in the Transition to Cockroach IPM

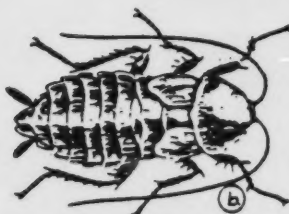
by William and Helga Olkowski, Kathleen Cowles, Kevin Hackett and Al Giraldo



Four cockroach management programs, recently undertaken in three schools and a large office building, show that one of the

major obstacles to adopting the IPM approach is the contract between the institution and the pest control company. In addition, these cases have shown: 1) that roaches can often be suppressed below injury levels with habitat and waste management techniques, trapping, and with minimal use of boric acid; 2) pest control companies do not regularly supply their clients with data for the client to use in judging program effectiveness; nor do they usually provide educational materials describing the role that clients can play in encouraging or suppressing roach populations.

Description of Studied Cases



Personnel of the center for the Integration of the Applied Sciences (a division of the John Muir Institute, Inc.), working in three U.S. cities with funds provided by the Charles Stewart Mott Foundation and the Environmental Protection Agency,

are studying how to implement demonstration IPM cockroach projects. Two elementary schools were selected in Washington, D.C. (Key and Amidon), while one was chosen in Flint, Michigan (Cook), for initial demonstrations. The Washington school district manages its own pest control, while the Flint school district hires outside services. An office building used for study of IPM cockroach implementation, the Parklawn Building in Beltsville, Maryland, houses the headquarters of the Public Health Service, the Center for Disease Control, the Food and Drug Administration and the Secretary of the Human Health Services Agency. About 8,000 employees work in this building on 18 floors and three wings. The building has a large cafeteria and four small food stores. It is owned privately but is leased by the General Services Administration to other federal and various private companies. The General Services Administration hires a maintenance company for the building, and this firm hires a pest control company. A different pest control company is hired by the cafeteria management.

Program Elements



The program, designed for implementing IPM in the study locations described above, included the following elements: 1) education of building management, pest management personnel, and employees/tenants/students; 2) monitoring, using commercially available roach traps; 3) establishing a record keeping system; 4) habitat modification (at Cook); 5) alteration in waste management practices; 6) selective use of boric acid (at Cook).

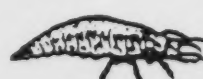
The educational component involved periodic meetings with pest control companies, management personnel, custodians, principals, teachers, students and employee groups. The objective of this work was to describe what is known about cockroach IPM and to reach agreements on the next steps in implementing the program. The modes of interaction included lectures, group meetings, and contact in person or by phone for discussion of program objectives and procedures. Educational materials and papers were distributed which described the overall program. Memos summarizing discussions and agreements achieved in meetings were also used.

The monitoring component involved placing traps in appropriate locations and returning at regular intervals to read trap captures, replace traps, and compile records of roach numbers. Trapping was started in all cases while routine insecticide treatments continued. After a trapping period of at least one month, during which one or more normal insecticide treatments, and two or more trap readings were made, the routine insecticide treatments were halted. Thereafter, it was agreed that pesticide treatments would occur only where trap catches were excessive. The actual trapped numbers considered excessive were not specified initially. The original project design stated that after the initial trapping program was established, it would be taken over by existing maintenance personnel, or a local pest control firm.

The record keeping component included records of trap locations and catches, all insecticide treatments (trade name, formulations, active ingredients, time, place, personnel making the applications, and any difficulties encountered), and all visits and other relevant observations. The results of treatments and trap catches should regularly be transmitted to pest management personnel. Records were also kept of habitat modifications and changes in maintenance practices. These records were correlated with changes in roach populations and helped in evaluating treatments.

The IPM Practitioner, Dec., 1981, Rte. 1, Box 28A, Winters, CA 95694

This column, developed by the staff of the Center for the Integration of the Applied Sciences, a division of the John Muir Institute, under a cooperative agreement with the U.S. Environmental Protection Agency, is a regular feature of *The IPM Practitioner*. Information contained in this column was not reviewed in advance by the EPA, and the authors are solely responsible for its content.



The habitat modification component sought to eliminate roach habitats (cracks in walls, around pipes, behind and within cabinets, in furniture, etc.), and to deny food and water to roaches by sealing food storage containers, fixing water leaks and screening air vents and water drains. This approach requires the use of caulk, caulking guns, paint, putty, patching compounds, and weather stripping screens. Habitat modifications were scheduled sequentially, beginning after base line data was collected, and shortly after cessation of normal insecticide treatments. It was concentrated where trap catches were highest.

The waste management component was concerned with discovering the connections between pest populations and wastes. For example, roaches feed on waste food scraps and grease collected on kitchen walls, equipment, drains, floors, and in waste receptacles. Changes in maintenance practices can reduce food sources.

The selective chemical component involved the use of boric acid in certain areas to augment habitat modification and waste management procedures. Such areas include wall voids, under kitchen equipment, behind cabinets, under stoves, near motors, etc. (Areas regularly exposed to moisture should not be treated with boric acid, as moisture may render it ineffective. Care also needs to be taken to prevent food contamination.)

Findings



In all cases, before initiation of the program, organophosphate insecticides had been applied regularly on a calendar basis. Initial trapping results revealed many areas which received routine treatments but where no roaches were trapped. In other areas, very few roaches were trapped (less than five over a two week period). Only a portion of the total areas showed larger numbers trapped (20-50 over a two week period). As a result of these findings, routine insecticide applications were eliminated without increases of roach populations and with no other program modifications except trapping and spot treatments with boric acid in areas with the highest catches.

During collection of base line data, while routine insecticide treatments continued, large roach populations were present in certain areas. When insecticide treatments were suspended, and habitat and waste management were instituted, the same roach populations were observed to drop (Figure 1). Clearly, the IPM program was more effective than routine insecticide use. However, even in the face of this evidence, adoption of the demonstrated procedures has not taken place where contracts exist with outside firms in the Parklawn Building and in the Flint school system. In the Parklawn Building, both the pest control company and building maintenance personnel expressed interest in the IPM program, and approval of its techniques and results (particularly reduced occupational exposure to pesticides). However, it was made plain that no changes could occur as long as the contract specified routine pesticide treatments and did not require other IPM program components. The one school system that has agreed to adopt IPM techniques is the one in Washington, D.C. where the district has its own in-

TOTAL NUMBERS COCKROACHES TRAPPED

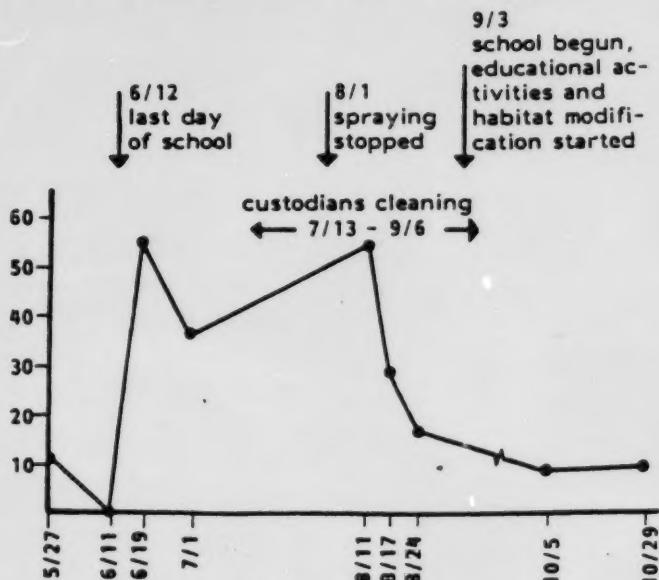
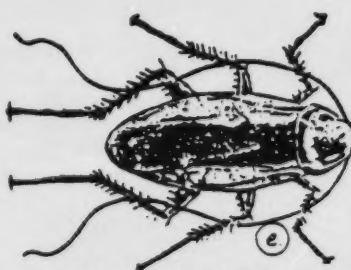


Figure 1: Roach trapping results, Cook elementary school, Flint, Michigan, summer, 1981. 32 trap locations. (Similar patterns were observed in all sites monitored.)

ternal pest control unit. Apparently, this will allow them to shift to new procedures without having to obtain new contract specifications.

Conclusions



If this study is indicative of the situation nation-wide, and we believe it is, then in order to encourage the adoption of IPM procedures, contract specifications need to change. We suggest that new contracts specify the components used in the above demonstration projects: 1) monitoring, using roach traps in an initial survey to indicate areas which subsequently will be treated; 2) continued trapping at three month intervals to evaluate sizes and distribution of roach populations; 3) delivery of copies of records from trapping efforts; 4) a proposed plan submitted to the client for habitat modification and selective chemical treatments; 5) delivery to the client of records of chemical and other treatments at the conclusion of each visit; 6) a plan for delivery of educational services, developed with and approved by the contracting officer. Until these or similar specifications are built into pest control contracts, and tested for workability, IPM developments for cockroaches will be delayed.

COCKROACH BIOLOGY AND BEHAVIOR

The four major cockroach pest species discussed in this manual are the German cockroach, Blattella germanica, the brown-banded cockroach, Supella longipalpa, the American cockroach, Periplaneta americana, and the oriental cockroach, Blatta orientalis. The German cockroach is often considered the most important household pest in the United States with the American cockroach second to the German in abundance in many large commercial buildings.

Physical Characteristics

The cockroach body is oval and flat, enabling roaches to squeeze into very small cracks and crevices. A pronotum (shield-like covering) projects forward over the head. Two pairs of wings and three pairs of legs are attached to the thorax, the mid-region. The abdomen, or posterior part of the cockroach body, consists of 7 to 8 segments. Most cockroaches can climb smooth vertical surfaces and run rapidly with their long spiny legs.

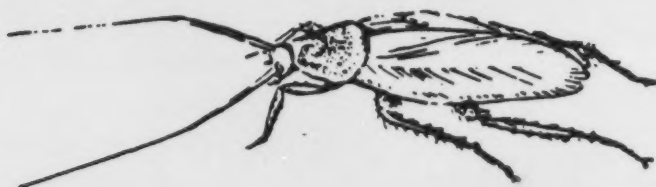


Adult cockroaches of the 4 pest species differ in size and color and have key characteristic markings. The German cockroach is approximately 1/2" long. It is light to medium brown and has 2 black streaks running lengthwise down its back. The female is darker and has a broader abdomen than the male, and is rounded posteriorly. If placed on their backs, the males are easily distinguished by a yellowish, slender abdomen, which tapers gradually to the posterior end.

The brown-banded cockroach is also about 1/2" long. It too is light to medium brown. However, it has 2 light bands running crosswise over its back. The abdomen of the female is much broader and more rounded posteriorly than



that of the male. The wings of the male cover the abdomen completely, while the wings of the female are short and do not cover the entire abdomen. Males may often be seen flying when a colony is disturbed, but the females cannot fly.



The American cockroach is around 1-1/2" long. It is reddish-brown in color throughout except for a pale-brown or yellow band around the edge of the pronotum. The males appear to be considerably longer than the females because their wings extend beyond the tip of the abdomen, while those of the females do not. Males and females are about the same width.

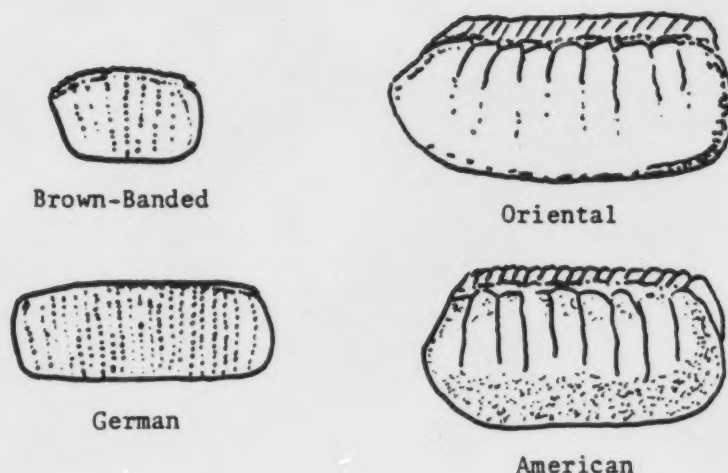


The adult oriental cockroach can be up to 1" in length. The male is much narrower than the female. Both sexes are usually black, although they may be dark reddish brown. The female has small, rudimentary, functionless wings, and the male, although it has well-developed wings covering about 75% of its abdomen, does not fly. This species lacks an adhesive organ between the claws and so cannot climb smooth, vertical surfaces. It is also relatively sluggish in movement.

Lifecycle

The cockroach life cycle consists of three stages: the egg, nymph and adult. The female produces a purse-shaped egg case called an ootheca. It has one ribbed keel that indicates the margin that will open to release young nymphs. The oothecae vary in size, shape, color and texture among the species. The German cockroach carries her ootheca throughout most of the embryo

development. The eggs become dried out if the ootheca is removed from the female before its normal time to drop, for they must obtain moisture from the body of the mother. Other cockroach species attach their oothecae to solid surfaces or deposit them under debris in protected locations shortly after formation. Nymphs (immature cockroaches) emerge from the ootheca and undergo a series of molts (shedding of skin as they grow). Nymphs look like small adults, but are wingless.



COCKROACH OOTHECAE (EGG CAPSULES)

Living Preferences

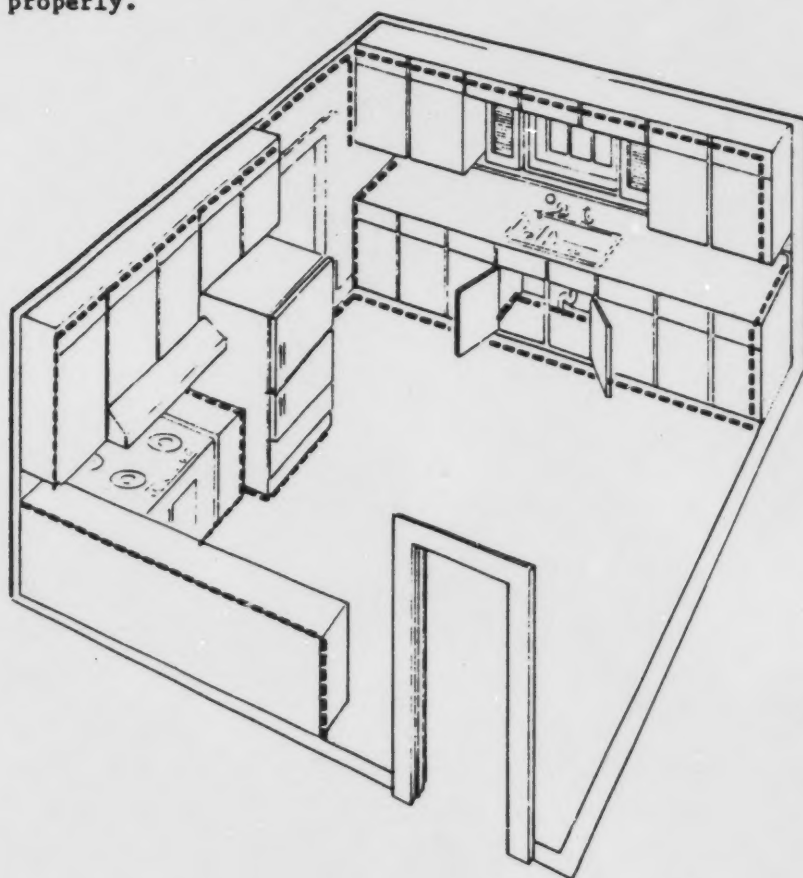
Cockroach species found living in human habitations all originated in north or tropical Africa. Therefore, they are most likely to breed in warm moist places that resemble a tropical environment, where there is good access to food and free water. While they are capable of withstanding limited exposure to very hot, cold or dry conditions, major infestations of cockroaches usually occur where temperatures are about 75-85 F.

Cockroaches tend to avoid brightly lit places and will scurry away when suddenly disturbed. Light periods are generally spent in dark, hidden undisturbed areas. Dark periods are spent venturing forth in search of food

and water. Feeding activity is greatest about two hours after a dark period has begun.

Cockroaches have a preference for edges, small spaces and intersections (where wall meets floor, furniture meets floor, etc.). They thrive best when both their upper and lower body surfaces are in contact with surrounding structures (thigmotropism). When moving from place to place they travel along intersections rather than crawling about indiscriminately in the middle of an open area.

The individuals of some cockroach species (including the German cockroach) tend to cluster and stay in groups. The physical presence of other cockroaches is necessary for the nymphs of these species to grow and develop properly.



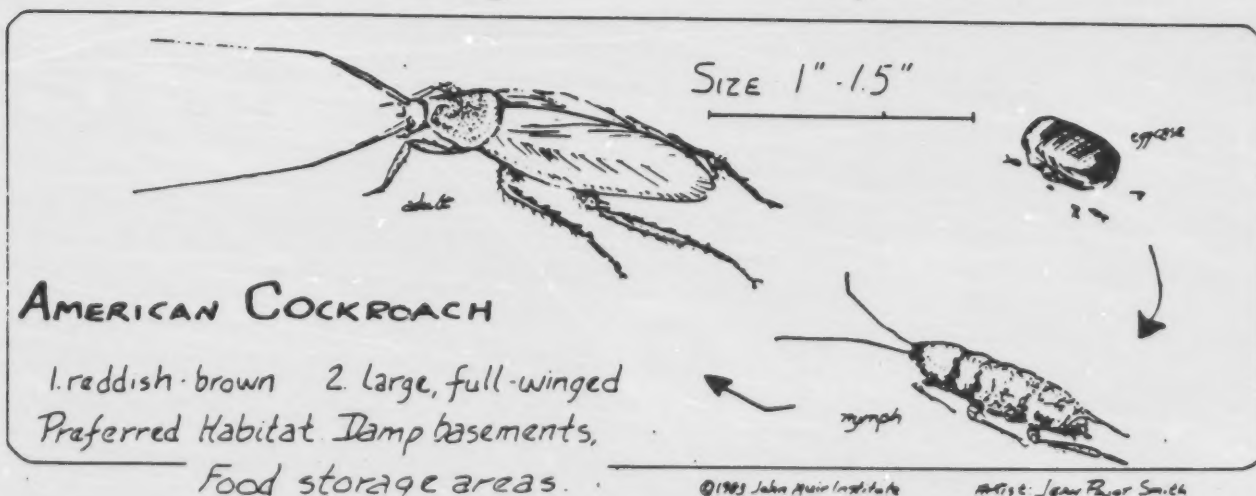
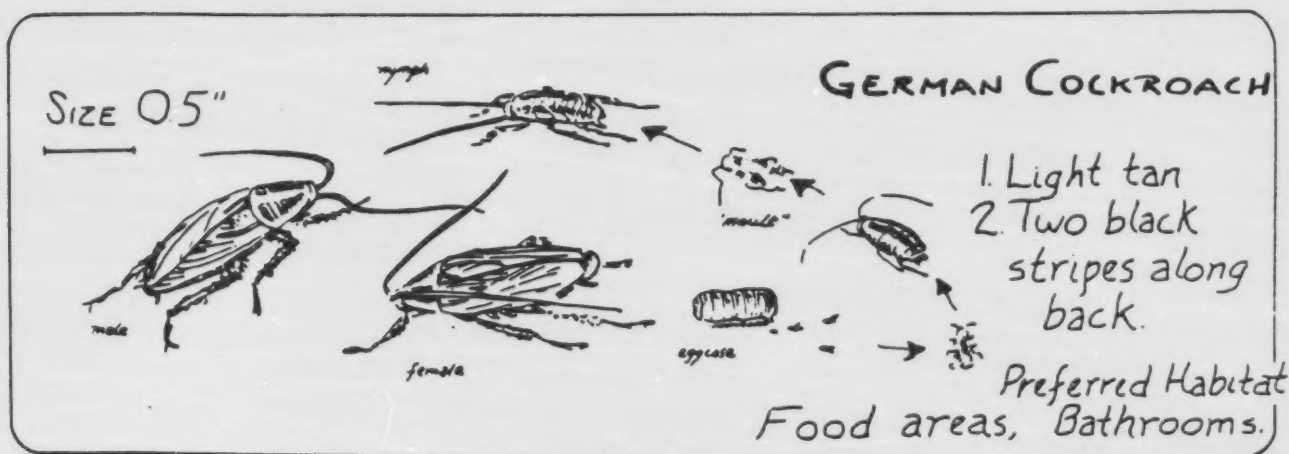
----- Preferred
routes for cockroach
travel.

Source of drawing:
Slater, 1978.

PEST COCKROACHES: A GENERAL SUMMARY

- INTRODUCTION: There are 3500 to 4000 species of cockroaches with fewer than 1% reported as pests. The German cockroach is often considered the most important household pest in the United States. The American cockroach is second to the German in abundance in many large commercial buildings. Cockroaches originated in tropical or semitropical Africa approximately 250 million years ago. Most species are currently found in the tropics, but pest species are usually cosmopolitan.
- PHYSICAL CHARACTERISTICS: Head; oval and flat, covered by a large, shield-like pronotum
Thorax; attachment site for 2 pairs of wings and 3 pairs of legs
Abdomen; usually covered by the wings
Most young and adults have an adhesive organ between their claws that allows them to climb smooth vertical surfaces. Cockroach young (nymphs) look like adults but are wingless.
- REPRODUCTION: Eggs are laid in purse-shaped cases called oothecae
- DEVELOPMENT: Cockroaches thrive between 72 - 85 F, but can briefly survive temperature extremes if enough food and water is present. Their greatest reproductive potential is around 80 F, at 60-75% relative humidity. Nymphs are white upon hatching, but darken within a short time. Nymphs develop in stages (instars) and molt between each stage.
- BEHAVIOR: Cockroaches prefer edges, intersections and small spaces that protect them from enemies and water loss. They usually avoid bright lights, but may become accustomed to a calm, brightly lit location.
- HARBORAGE: Cockroaches prefer warm, humid, dark places with easy access to food and water. They can flourish wherever plenty of cracks and crevices exist.
- FOOD/WATER: Cockroaches prefer starchy and sugary foods. They will readily feed upon bread, potatoes, animal meals or chow. They can also eat animal feces, dead animals, plant materials, pastes, glues, leather, hair, wallpaper, fabrics and starch in book-bindings. Feeding activity is greatest about 2 hours after dark. Water is an important component of the diet. If deprived, roaches are able to obtain moisture from fruits and damp vegetables. Cockroaches can survive several weeks with no food or water.

GUIDE TO THE ROACH SPECIES



ROACH FOOD AND WATER SOURCES,
HARBORAGE AND POINTS OF ENTRY

All rooms within a structure (kitchens, cafeterias, lounges, storage rooms, custodian closets, furnace rooms, bathrooms, utility rooms, classrooms, bedrooms, etc.,) should be evaluated for the three basic life needs of a cockroach: 1) food sources, 2) water sources, and 3) harborage, as well as for 4) points of entry. The workgroup with monitoring responsibilities (generally the PCO workgroup) should record all observations on a Trap Monitoring Form and recommendations for corrective action on a Cockroach Control Work Summary so that remedial work can take place.

Food Sources

Cockroaches eat a wide variety of substances. They prefer starchy and sugary foods to fruit or meat. They'll readily feed on bread, potatoes, or animal meals or chow, but will also eat pastes, glues, fabric and starch in book bindings, wallpaper, hair, leather, animal feces, dead animals and plant materials.

Things to look for include:

- uncovered food
 - human food and snacks within cafeteria and other rooms on counters, shelves, in desks
 - animal food for pets and lab animals
 - open containers of pastes, glues and paints
- uncovered wastes
 - cafeteria lunch scraps and wastes
 - snack food wastes in room wastebaskets
 - cage wastes from pet and lab animals
- lack of sanitation
 - dirty counters/cabinets/tables
 - unclean bathrooms
 - unswept floors
- greasy vents, stove tops, hot plates, ovens, drains, refrigerators in food preparation areas (cafeteria, kitchen, lounge areas)
 - custodian closet sinks and drains

Water Sources

Free water is a necessary part of the cockroach diet. However, if deprived, cockroaches are capable of obtaining moisture from fruits and damp vegetables. Observation of fecal pellets will indicate if water is in short supply. Soft, partially solid pellets will be discharged from well-fed roaches with access to an adequate supply of free water. Dry fecal pellets will be discharged if free water is scarce. However, German cockroaches are capable of living for several weeks with no water or food at all. American cockroaches can live for more than a month without water or food (Willis and Lewis, 1957). Experiments have shown that water limits roach survival more than food.

Things to look for include:

- leaky pipes, faucets, etc.
 - bathrooms
 - kitchens
 - custodian sinks
 - water heaters
- damp areas
 - kitchen floor
 - refrigerators/coolers
 - bathrooms
 - basement rooms

Harborage

Cockroaches prefer dark, hidden, undisturbed areas. They may live within cracks, crevices, and intersections (e.g. where wall meets wall and wall meets floor). They may live within and behind furniture; in cabinets, cupboards, drawers and closets; underneath and within the insulation of refrigerators and stoves; underneath loose wallpaper and tiles; behind blackboards; underneath clutter, furnaces and hot water heaters; within drains; behind toilets; and even in electrical appliances such as radios, televisions, and clocks.

Things to look for include:

- clutter
- loose shelf paper, tiles, bulletin boards, chalk boards, wallpaper
- cracks and crevices in walls or around doors or windows

Points of Entry

Cockroaches are often introduced into a building along with shipments of food supplies. Adults and egg cases can be found between flaps of cardboard boxes or paper bags. Roaches may also be accidentally carried into an area along with new or used appliances or furniture. Once within the structure, cockroaches can spread from room to room by following utility pipes, air ducts or ventilators.

SIGNS OF AN INFESTATION

A visual sighting is the most frequent indicator of a cockroach infestation. Cockroaches may reside unnoticed for several months because the population is small and individuals avoid appearing in the light. The first evidence of their presence may be the sight of one scuttling for cover when a light is suddenly turned on in a dark room.

In addition to the insect itself, roach presence may be indicated by brown fecal smears, pellets or droppings on previously clean surfaces. Cockroach egg cases (oothecae) may be scattered about or glued in place with a secretion produced by the female.

Occasionally droppings and oothecae are found when no adults appear to be present. This occurs when only the adult population has been eliminated (usually by a chemical poison) and thorough cleaning has not taken place. Oothecae attached to surfaces contain eggs that may live for as long as 90 days before hatching. For this reason, it is important to destroy any oothecae that are seen. If they are ignored, it will eventually appear as if roaches have reinfested the area, whereas actually the original infestation was not completely eliminated.

If it is suspected that a cockroach population resides in all or part of a school building, it will be necessary to survey existing conditions to:

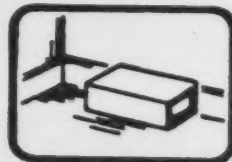
- Determine the actual and/or potential locations of the infestation by observing food handling and waste management practices and structural conditions including sources of water, cockroach harborage and points of entry.
- Evaluate whether or not cockroach numbers are high enough to justify suppression with roach traps or an insecticide in addition to changes in food and waste management and structural repairs.

HOW TO MONITOR FOR COCKROACHES

Cockroach populations can be monitored by means of commercially available traps. These are small cardboard boxes with openings on two ends. The interior of the box is covered with a non-toxic sticky substance and is baited with a cockroach attractant.

How to Survey for Roaches:

- Obtain a Trap Monitoring Form that includes the floor plan of the school building from the Office Coordinator.
- Survey all rooms suspected of having roaches plus all food and waste handling areas and bathrooms.
- Place one to two traps in each of these rooms. Place up to 10 traps in large food handling areas. German, American and brown-banded roaches can be caught on the floor or shelves. Oriental roaches will probably be caught on the floor.
- Place traps broad side down along wall edges and at intersections.



Mark trap location on the Trap Monitoring Form (F = floor, S = shelf, etc.).

- Check traps during the following site visit (monthly basis) to determine severity of the roach infestation (and/or the effectiveness of your treatments). Count the number of roaches within the traps. Most will be stuck to the bottom broad side. Record the counts on the Trap Monitoring Form. Include the species if identifiable. Don't forget to date and sign the Form.

- If roaches were caught, either replace the traps with new traps or turn the used traps over so that the opposite broad side is on the bottom. Most roaches are trapped on the bottom side, thus the trap can be used twice. The second time the trap is checked, count only those roaches on the lower half of the box. Once both broad sides have been used, the trap is no longer useful for monitoring and should be replaced with a new one.

How roach surveillance saves time, material, and labor

by James T. Kardatzke, CPT, MSC, Irving E. Rhoderick, and James H. Nelson, PhD¹

Cockroaches impact severely on man's domestic environment. They represent a major source of potential contamination to his food. To the Army, management of cockroach problems represent major manpower and fiscal expenditures. Monthly pesticide usage reports indicate that Army pest control personnel devote approximately 75% of their time and pesticides to cockroach control. Through scheduled treatments (frequently as often as weekly), the Army dispenses tons of cockroach baits and dusts and thousands of gallons of pesticide sprays in an effort to control cockroaches. The magnitude of expenditures for cockroach control and recent presidential directives mandate development and adoption of procedures which will insure optimum efficiency of manpower and control materials.

Fort Detrick is a small military installation located in Frederick, MD, about 40 miles northwest of Washington, DC. Because of its size, Fort Detrick has only two major food facilities. The first of these is a military dining facility which is in continuous use, serving three meals throughout the day. The equipment and facilities are modern and well-maintained. The

major source of a continuing cockroach problem at the dining facility is a periodic influx of German cockroaches with weekly shipments of fresh food. The second major food facility is a small consolidated club. This club routinely only serves lunch with periodic dinner meals and special-purpose banquets. The old building has been remodeled several times and contains a multitude of cockroach harborages.

How many RO per complaint?

Prior to 1978, cockroach control in the food handling facilities at Fort Detrick involved sole reliance on residual treatments with Baygon®. The only "surveys" per-

formed were occupant complaints and subjective estimates of cockroaches flushed during the Baygon treatment. During 1976 and 1977, prior to adoption of a surveillance program for cockroaches, the club and dining facility averaged, respectively, 48 and 37 residual spray treatments each year (Table 1). Early in 1979, surveys using sticky traps (Mr. Sticky® Traps) were initiated to determine cockroach population indices which equated to initiation of an occupant complaint. The population indices were determined to be 2.5 cockroaches per trap per night for both the club and the dining facility, when the surveillance program was established. This infestation level of 2.5 cockroaches per trap per

MONITORING EFFECTIVE IN INTEGRATED PEST MANAGEMENT (IPM)

Table 1. Yearly benefits derived from use of a sticky trap surveillance program for German cockroach control in food facilities on Fort Detrick, Frederick, MD 21701.

Facility	Visits (#)		Labor	Pesticide Used
	For Control	For Survey	(Man-Hours)	(Gal)
Club				
Pre-IPM	48	0	96	96
With IPM	11	22	33	18
% Reduction	77%		66%	81%
Dining Facility				
Pre-IPM	37	0	60	37
With IPM	20	24	42	18
% Reduction	46%		30%	51%
Total Reduction	64%		52%	73%

Table 2. German cockroach populations (Cockroaches/Trap/Night) as measured by Mr. Sticky Traps before and after adoption of the surveillance program.

TREATMENT THRESHOLD*				
	Residual	Residual and Fog	Post-Treatment Cockroach Population*	Mean-Time Between Treatments Over Two Years
Pre-IPM	2.5	N/A	1.0	9 days
With IPM	2.5	5	0.7	24 days

*Cockroaches/trap/night.

¹The findings in this report are the personal views of the authors and not to be construed as official Department of the Army or Department of Defense position. Use of proprietary names does not imply endorsement by the US Army or Department of Defense.

²The authors are employed at Fort Detrick, Frederick, MD. Captain Kardatzke and Dr. Nelson are attached to the U.S. Army Medical Microbiology Research and Development Laboratory. Mr. Rhoderick is the foreman of the pest control shop at the U.S. Army Garrison at Fort Detrick.

night was used as the treatment threshold for residual chemical control. Because of the preparation required for a residual spray combined with aerosol fogging of pyrethrins, the threshold for this operation was set at 5 cockroaches per trap per night, thereby limiting the disruptive actions of fogging operations on the facility. Control activities were no longer initiated by occupant complaints but only through surveys using sticky traps. The traps were used once each three weeks or in response to an occupant complaint. Programs of harborage reduction and improved sanitation were also initiated.

Traps signal callback

Over the last two years, the surveillance program against cockroaches has resulted in a significant reduction in man-hours and pesticides used to control cockroaches. The total number of visits for the sole purpose of dispensing chemicals was reduced to 65% (Table 1). Even including survey visits, there was a 7% reduction of visits. At the same time, labor costs, as measured in man-hours expended, was cut by 52%, primarily because surveys using sticky traps are labor efficient (Table 1). Important to the environment is the major cut in pesticides used. Prior to use of sticky trap surveillance, 133 gallons of 1.5 Baygon were used yearly on Fort Detrick for cockroach control in these two facilities. This was cut by 73% to 34 gallons of 1.5 Baygon and 2 gallons of pyrethrins when surveillance procedures were used to initiate treatment. Table 2 demonstrates the effectiveness of the surveillance program. Using fewer man-hours and insecticides, better control of the cockroach problem was attained in both facilities.

Surveillance is an essential component in the control of cockroaches. The selective use of chemical pesticides with a conscientious application of population monitoring can result in good control at lesser expenditures of man-power and chemicals. This small Army program at Fort Detrick has demonstrated the worth of sticky-trap surveillance for cockroaches. It also demonstrates the potential capabilities for saving money and manpower. *

Source: Pest Control
48(6):46-47.

COCKROACH MANAGEMENT: HABITAT MODIFICATION

The importance of habitat modification in achieving comprehensive, long-term cockroach control cannot be overstressed. A direct relationship (1% level) has been observed between the number of cockroaches visually counted and the sanitation grade of a dwelling; as the filth increased, the number of cockroaches increased (Wright, 1979). Without elimination, or at least reduction, of the three basic cockroach needs (food, water, habitat), no suppression technique will be effective.

Habitat modification includes:

- 1) Appropriate cleaning schedules
 - a) Timely emptying of waste receptacles, both food and non-food.
 - b) Timely and thorough cleaning of food preparation areas (counters, tables, stoves, refrigerators, vents, drains), restrooms and classroom animal facilities.
- 2) Proper storage and rotation of food and non-food stocks.
- 3) Proper insect-tight and rodent-proof garbage and refuse storage.
- 4) Immediate repair of leaks in faucets, drains, sinks, boilers.
- 5) Removal of clutter and all items not of use or function.

These actions are often referred to as sanitation.

In addition, habitat modification should include:

- 1) Caulking of cracks and crevices within the building.

Adult German cockroaches can hide in a crack 1.6 mm (1/16th inch) wide. They can use cracks and crevices in floor, walls and ceilings, around plumbing and electrical fixtures, around door and window frames, along baseboards and molding to hide in or to gain access to the facility. Thorough caulking (or other appropriate methods of sealing) of small gaps will help eliminate hiding spaces and access points.
- 2) Structural repairs both within the building and between the exterior and interior of the building.

In areas of few or no cockroaches, habitat modification alone may be sufficient to effectively control or prevent the occurrence of a cockroach infestation. In areas of moderate to severe infestation, habitat modification

will greatly reduce the cockroach population. However, remaining individuals could migrate in search of other food, water and harborage sources. Depending on the location within the facility, this might be objectionable. Therefore direct suppression techniques may be used at the same time to immediately reduce the cockroach population.

The areas most in need of habitat modification will be initially identified when the building is evaluated for cockroach food and water sources, harborage and points of entry. Usually these areas will correspond with high roach populations. At first, the amount of needed habitat modification may appear overwhelming. If this is the case, set up a time line in which work will begin on the worst areas. As this is completed, make the needed habitat modifications in other areas.

Barriers/Exclusion

Reintroduction of cockroaches can be kept to a minimum by preventing their access to the facility. A direct barrier of screen should be used on open windows, vents, conduits, etc. to limit free movement of the insects.

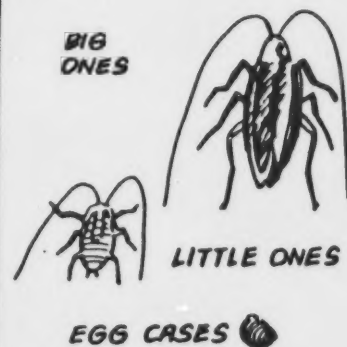
Containers used in shipment of food items should always be checked for insects and their egg cases. These should be removed from the facility as quickly as possible. Often adults and egg cases can be found between flaps of cardboard boxes or paper bags. The adults prefer these darkened locations with close surface contact. The egg cases may be either attached to the container or loose, depending on species.

Used appliances and furniture should also be checked before being brought into a facility. Again both the insect and the egg cases can be found in and on the item. The cooling unit of a refrigerator and the section of a stove under the burners are favored cockroach harborage.

Things to look for include:

- infested food shipment packaging
- infested new or used furniture and appliances
- spaces around utility pipes, air ducts or ventilators
- unscreened vents

YOU WILL SEE :



TO LIVE AND MULTIPLY,
COCKROACHES NEED:

● WATER



● FOOD



● HIDING
PLACES



HOW TO GET RID OF COCKROACHES

1. TAKE AWAY THEIR FOOD

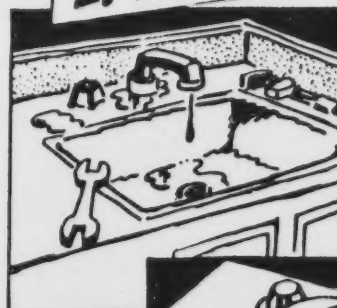


Use containers with tight-fitting lids to store your flour, crackers, sugar, and cereal, or — keep it all in the refrigerator.



Clean all storage shelves and drawers. Paint shelves with enamel. Do not use shelving paper.

2. TAKE AWAY THEIR WATER



Fix all leaks.



Keep all areas clean and dry.

3. TAKE AWAY THEIR HIDING PLACES



CLEAN OUT JUNK AND CLUTTER!

- Throw out or recycle old newspapers, empty bottles, and cardboard boxes.
- Get rid of unused furniture, appliances, food, and clothing.

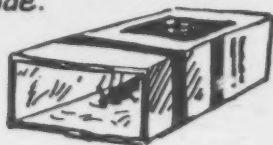


- Caulk ALL cracks and crevices.
- Seal openings around pipes.
- Remove chipped paint and loose wallpaper.
- Replace broken tiles.

HELPFUL TOOLS

COCKROACH TRAPS

Small cardboard boxes lined with sticky glue trap roaches inside.



Non-toxic. They can be used in kitchens.



Place next to a wall, counter, or cabinet where roaches run.

Traps are available in most supermarkets and hardware stores.

63 Traps tell you where the roaches are... and where you need to do more caulking, and cleaning.

BORIC ACID DUST

Doesn't mix with the air — you don't breathe it.

Put powder into a plastic squeeze bottle for easy application — label as shown.



Apply a thin, even dusting to inaccessible cracks where roaches can hide.



Dust under and behind the stove, washer, cabinets, & refrigerator.

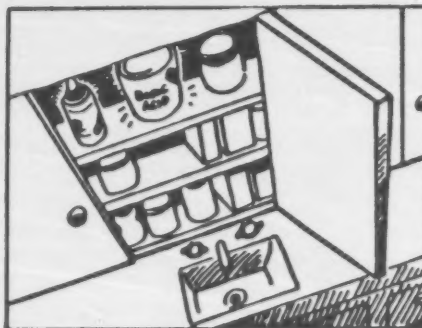


Blow dust into all inaccessible cracks and openings in floors.

REMEMBER: First remove the roaches' food, water, and hiding places. Dust alone is never ENOUGH!

BORIC ACID IS A PESTICIDE AND A POISON. READ THE LABEL CAREFULLY!

- Do not apply near food, near food preparation areas, or on cooking pots, pans, or dishes.
- Do not apply to places that children or pets can reach.



- Store out of children's reach and away from food.
- Avoid inhaling the dust — and wash your hands after use.

TEXT: KATHLEEN LETCHER COWLES
ILLUSTRATION: LEE MARRS -
PRODUCED BY: CIAS, A DIVISION OF JMI,
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SAFETY, N.Y. STATE DEPT. OF HEALTH
BROCHURE.

FOR FURTHER INFORMATION, CONTACT:

COCKROACHES



**YOU CAN GET
RID OF THEM!**

Cockroach

Likes



food in open trash containers



food left on counters and stoves and dirty dishes



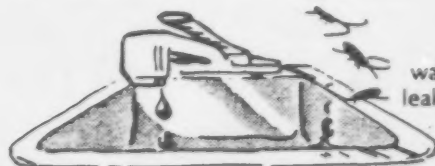
food stored in boxes



pet food left out



cracks around sinks, counters and baseboards to hide in

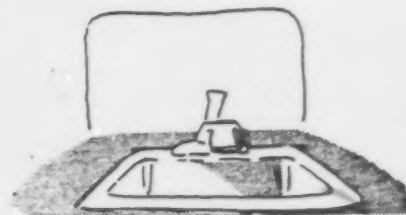


water from leaky faucets

Dislikes



lids on food garbage containers



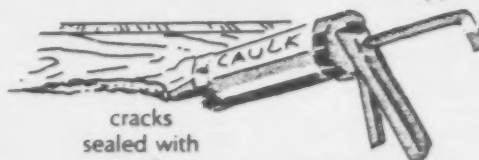
clean counters with dishes washed or soaking in soapy water



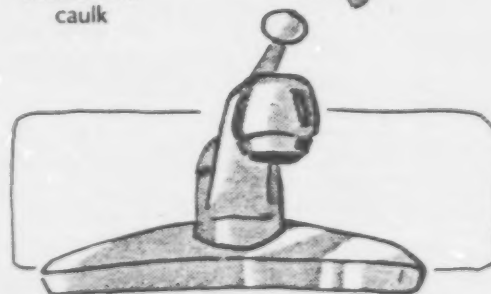
food stored in sealed containers



pet food in a bowl of soapy water



cracks sealed with caulk



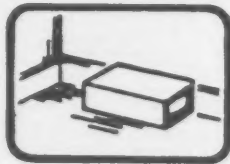
leaky faucets repaired

COCKROACH MANAGEMENT: DIRECT SUPPRESSION

Direct suppression will reduce a cockroach population but does not change the area's capability of supporting the original number of insects. Therefore, direct suppression techniques should not be used alone when first developing a cockroach control program. Some habitat modification is always possible which will reduce the three basic cockroach needs thereby reducing the area's ability to support so many cockroaches. However, in certain cases it may not be possible to remove all sources of food, water or harborage and the remaining population, though low in number, may still be intolerable. Then repeated direct suppression techniques may be necessary. Examples include areas underneath and behind stoves and refrigeration units. The two direct suppression options are trapping and poisoning.

Trapping

Traps are most practical in areas with low infestations and in those where insecticides are unadvised (counters, food preparation tables, etc.). Most commercially available traps, e.g., Raid Roach Traps^R, Zoecon Black Flag Roach Motels^R, resemble large kitchen match boxes with open ends. The inside is lined with a sticky material similar to fly paper. Some also contain an attractant substance. These traps should be placed broad side down along edges and intersections.



As most roaches are caught on the bottom side, the traps need to be turned over after a period of time so that the opposite unused broad side is on the bottom. Once both sides are full, the trap is no longer useful and should be discarded.

Traps placed on both high surfaces such as counters and shelves, and the floor will trap German, American and brown-banded cockroaches. Oriental roaches will usually be trapped only in floor traps since they seldom climb.

Poisons

If an insecticide is necessary, the least toxic substance should be applied to the location where it will be most effective. Remember, all pesticides should be handled with care. Always follow the label instructions and be sure to store the poison out of reach of children and animals.

Effectiveness

Products containing boric acid as the active ingredient are the most effective roach insecticides. This effectiveness is not directly due to its toxicity, but is rather due to the fact that roaches are not repelled by it. Research has shown that more roaches are killed by a pesticide that doesn't repel them than by a highly toxic pesticide that they are able to avoid. It is easy for cockroaches to avoid most insecticidal residues in a building where they can (temporarily) withdraw to secluded cracks far away from the treated areas. Since cockroaches aren't repelled by the boric acid, they are more likely to continue to live (and die) in treated areas. This explains why boric acid can be less toxic and more effective than most other pesticides.

Flushing agents, such as pyrethrins, are occasionally added to an insecticide. Their purpose is to drive the insects out of hiding places. These have been considered useful in indicating location and abundance of cockroaches so that treatments can be focused. However, in the IPM program, this information is gathered from monitoring.

Pyrethrin is more toxic than boric acid. When added to boric acid treatments, it may help bring about a more rapid kill of cockroaches but this advantage is probably countered by the greater repellency of the resulting treatment. No significant difference has been found in the number of live roaches remaining in dwellings treated with boric acid and pyrethrins versus boric acid alone (Ebeling and Reiersen, 1973). (See Table on next page.)

Table. Percentage control of German cockroaches, based on the number trapped one and three months after application of insecticides with and without pyrethrin flushing agents.

Test no.	Insecticide	Date treated	No. of apts.	No. of roaches before treatment	Percent control in months	
					1	3
1	Boric acid (technical powder)	5-15-69	19	2510	97.4	95.5
	Boric acid + pyrethrins ¹	"	20	3427	98.6	95.9
2	Ronnel, 2% in base oil	7-16-69	17	3456	72.6	—
	Ronnel, 2% + pyrethrins ¹	"	15	2138	19.0	—
3	Propoxur 1% emulsion	7-17-69	17	2457	69.4	—
	Propoxur 1% + pyrethrins ²	"	16	2188	78.3	—
4	Malathion 2%	8-28-69	12	1819	91.7	—
	Malathion 2% + pyrethrins ¹	"	13	1869	81.9	—
5	Boric acid	10-18-69	18	2874	97.0	99.3
	Boric acid + pyrethrins ²	"	19	2153	95.5	99.4
6	Diazinon 1%	1-20-69	13	2203	96.1	—
	Diazinon 1% + pyrethrins ³	"	12	2076	98.4	—

¹Boric acid 98.0525%, magnesium stearate 1.0%, pyrethrins 0.0625%, piperonyl butoxide 0.625%, petroleum distillate 0.25%.

²Solution contained 0.1% pyrethrins and 0.5% piperonyl butoxide.

³Emulsion contained 0.1% pyrethrins and 0.5% piperonyl butoxide.

⁴Solution contained 0.3% pyrethrins and 2.5% piperonyl butoxide.

⁵Boric acid 98.81%, magnesium stearate 1%, pyrethrins 0.065%, and piperonyl butoxide 0.325%.

No trapping was done 3 months after treatment in the tests with organic insecticides because several years of experience have shown that reinfestation usually reaches intolerable levels in that period of time and cooperating managers and tenants usually demand additional treatments. Roach infestations treated with boric acid general tend to continue to decrease and will be found to be lower in 3 months than in 1 month after treatments in apartment buildings.

Source: Ebeling and Reiersen, 1973.

BORIC ACID: A SUMMARY

Serious infestations of roaches may require insecticide use in addition to the removal of the insects' food sources and hiding places ("habitat modification"). Safety, effectiveness, and pest resistance are the main factors to consider in selecting a poison. Cockroaches are repelled by pesticides they can smell. They are least repelled by boric acid (BA), an inert powder, and have not developed resistance in over 10 years of use.

Boric acid powder is most effective when applied as a dust. The simplest way to do this is to "poof" it into cracks through the nozzle of a plastic container. (Many of the available BA products are packaged in containers of this type, but those that aren't can be transferred to a well-labeled plastic ketchup bottle). BA dust should be applied where habitat modification is difficult, such as around stoves and refrigerators or in difficult-to-seal cracks. Once in place, the dust does not decompose and as long as it does not get wet, will remain effective indefinitely. Roaches walk through the dust and ingest the material while cleaning themselves. BA operates slowly, killing in 7 to 14 days.

Boric acid applied as a dust does not vaporize; thus it doesn't mix with the air that humans breathe. This characteristic alone makes BA much less harmful to the human environment than pesticidal sprays. However, although BA is much less toxic than most of the other available pesticides, it is still a poison and must be used and stored with caution. (About one ingested tablespoon can kill a child.) BA can also be absorbed through skin lesions or respired. Wear a dust mask if application methods throw boric acid dust into the air. If BA needs to be removed after application, wipe it up with a wet sponge while wearing rubber gloves. Do not sweep the powder. Keep boric acid away from food, children, and pests. Label and seal storage containers carefully.

Resist the temptation to turn to an insecticide as an easy way to avoid habitat modification. Make needed permanent changes in the environment first. Only use an insecticide if the changes alone are not sufficient.

BORIC ACID POWDER

Boric acid powder is a relatively safe and very effective chemical to use in treatments against cockroaches. It works as both a stomach and contact poison. Cockroaches walking through the powder pick it up on their hairy body parts. They are poisoned as they eat the material in the process of cleaning themselves and as the boric acid penetrates their cuticles.

Boric acid powder kills cockroaches more slowly than do most organic insecticides. Often, the first visible effect of a boric acid treatment is an increase in the number of insects seen as the dying cockroaches wander out from their hiding places. Control with boric acid usually takes 7 to 10 days. Since boric acid is an inert inorganic compound and does not decompose or evaporate, it continues to kill roaches as long as it remains in place and they walk through it. If is not removed from certain important harborage and breeding areas, such as under and behind refrigeration units and ranges, cockroach infestations generally tend to continue to decrease and will be found to be as low if not lower in 3 months than in 1 month after treatment (Ebeling and Reiersen, 1973).

Comparative Toxicity

In comparison to commonly used insecticides for cockroach control, boric acid is the least toxic.

<u>Substance</u>	<u>LD₅₀</u> * (in rats except where noted)
boric acid+	3160-4080
Dri-die	3160
borax++	2660-5190
sodium fluoride	75-110 (man)
ficam	60
pyrethrins	200
propoxur	90
diazinon	300
malathion	1375

<u>Substance</u>	<u>LD₅₀</u> * (in rats except where noted)
ronnel	1740
chlordane	250

*LD₅₀ is an expression of acute toxicity. It is the dose, given in milligrams (mg) of toxicant per kilogram (kg) of body weight, that kills 50% of the test animals to which it is administered under experimental conditions.

+Boric acid is a combination of hydrogen, oxygen and boron.

++Borax is a compound formed by a combination of sodium and boron.

Safety Precautions

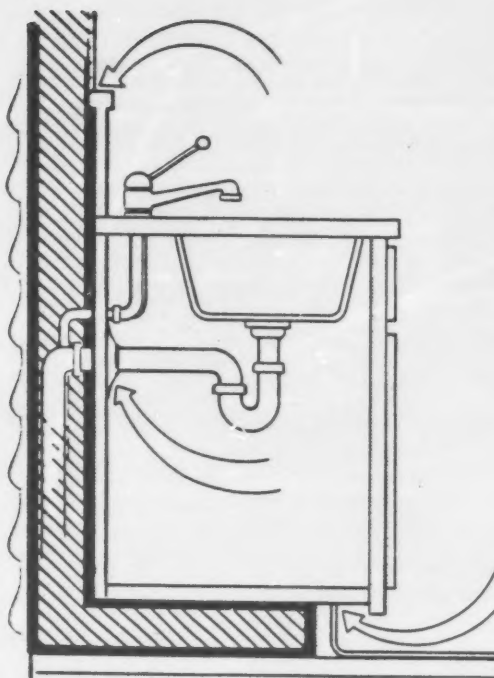
Although boric acid is relatively non-toxic, it is an insecticide and must be used cautiously. Even though boric acid solutions are often used as eyewashes and for irrigation of body cavities, poisoning has been reported when boric acid was applied as a body powder or ointment over large areas of denuded or burned skin. As cautioned on the label, boric acid should be applied only to out-of-the-way areas--beyond the reach of children or pets. Care must also be taken when applying the powder to not let it disperse into the air where the applicator might inhale it. Maintenance personnel must also be careful to not disturb treated areas. If removal is necessary, the area should be washed down rather than swept.

How and Where to Apply Boric Acid

Boric acid should be blown as a fine layer of dust into inaccessible cracks and crevices that harbor large populations of cockroaches. The dust can be forced into wall spaces through the cracks before they are caulked shut (follow label directions). Devices for applying dusts include plastic squeeze bottles, bulb dusters, Getz powder blowers, and pressurized dust applicators. Small amounts of dust applied forcefully enough to form a fine layer on all surfaces will provide the most effective treatment. (A thick layer of dust will cake and harden if it becomes wet. Hardened boric acid loses its effectiveness since it no longer sticks to the bodies of the insects.)

When a chemical treatment is necessary, consider applying boric acid to the following sites:

- cracks in infested cupboards and cabinets
- cracks along baseboards and wall/floor intersections
- under and behind stoves and refrigerators
- openings around plumbing and electrical installations



Small amounts of sorptive dust or boric acid powder may be blown under and behind stoves and refrigerators and counter and cupboard areas. Access to these areas may often be found at corners, through small cracks, and at plumbing and electrical installation openings in walls. The dark lines indicate a thin layer of dust or powder.

Source: Slater, 1978.

RETAILER'S CHART FOR COMPARING SOME INSECTICIDAL BORIC ACID PRODUCTS

PRODUCT/MANUFACTURER	WHOLESALE \$/POUND	QUANTITY	% BORIC ACID % OTHER	TYPE OF CONTAINER	PROFESSIONAL APPEARANCE
"Roach Killlll" Norshore Dist. Co.	1.58	25 lb. Bulk pail	99% Boric acid 1% ?	Bulk pail (retailer must pkg.)	---
"Roach Away" Willert Home Products	1.80	Case of 12, 8 oz. bottles	99% Boric acid 1% Inert	Plastic squeeze bottle w/cap	Yes
"Wipe Out" Wilbert Products Co., Inc.	2.36	Case of 12, 8 oz. cans	99% Boric acid 1% Inert	Can with plastic resealable top	Yes
"Doc Edmonds Roach Powder" North Carolina Chemical Co.	2.50	Case of 36, 15 oz. pkgs.	98% Boric acid 2% Inert	Cardboard container	No. Packages not sturdy.
"Roach Kil" R Value Inc.	2.60	Case of 12, 22 oz. bottles	99% Boric acid 1% Inert	Plastic bottle, screw-on lid & applicator brush	Yes
"Roach Killlll" Norshore Distributing Co.	2.72	Case of 24, 16 oz. cans	99% Boric acid 1% ?	Shaker top can	Yes
"Roach Kil" R Value Inc.	3.80	Case of 12, 10 oz. bottles	99% Boric Acid 1% Inert	Plastic squeeze bottle	Yes
"Neva-Mor Roach Powder" Rago Products Inc.	4.77	Case of 24, 16 oz. cans	99% Boric acid 1% Inert	Can	Yes
"Mr. Cucaracha" Ramick Chemicals	4.80	Case of 12, 10 oz. bottles	98.85% Boric acid 0.15% Methyl Myristate, 1% Inert	Plastic bottle, screw-on cap	Yes
"Roach Prufo" Copper Brite, Inc.	5.00	Case of 120 16 oz. cans	99% Boric acid 1% Inert	Non-resealable can	Yes
"Roach Free" Organic Distributors	5.85	Case of 12, 16 oz. bottles	99% Boric acid 1% Drying agent	Plastic squeeze bottle w/flip top	Yes
"Wheat Roach Super Shot" Wheat's Roach Shot	7.00	Case of 108 (minimum) 8 oz. bottles	97% Boric acid 2% Pyrethrine 1% Inert	Plastic squeeze bottle w/reseal- able cap	No. Bottle good but label hard to read (poor printing quality)
"Nott Roach Powder" Nott Mfg. Co.	7.33	5 oz. cans		Steel can, resealable	Yes

Note: This chart is a partial compilation of boric acid insecticide distributors developed to acquaint merchants with some information about boric acid products. The information is as accurate as possible as of December, 1981; however, CIAS/JMI cannot assume liability for errors or omissions. Purchasers are urged to contact manufacturers for further up-to-date information. Experience in the field indicates that plastic squeeze bottles are the easiest containers to use to apply the dust, while the can containers are more difficult to use.

CIAS/JMI 12/81
Revised 8/82

BORIC ACID DISTRIBUTORS

Doc Edmond's Roach Powder
North Carolina Chemical Company
P.O. Box 294
Belmont, North Carolina 28012
(704) 825-9392
attn: John L. Haney

Roach Kill
R Value Inc.
3128 Nifda Drive
Smyrna, Georgia 30080
(404) 355-9366

Mr. Cucaracha
Ramick Chemicals
P.O. Box 19289
Washington, D.C. 20036
(202) 387-3977
attn: Michael J. Levy

Roach Killlll
Certox
Distributed by:
Norshore Distributing Company
P.O. Box 162
Lake Forest, Illinois 60045
(312) 234-4800
attn: Joe Farmer

Neva-Mor Roach Powder
Rago Products Inc.
597 Crescent Avenue
Bronx, New York 10458
(212) 933-5343
attn: Peter Rago

Roach Prufe
Copper Brite Inc.
5147 W. Jefferson Blvd.
Los Angeles, California 90016
(213) 933-9331
attn: Alan Brite

Nott Roach Powder
Nott Manufacturing Company
Pleasant View Road
Pleasant Valley, New York 12569
(914) 635-3243

S.A.J. Borated Powder
907 American Avenue
Waukesha, Wisconsin 53186
(414) 542-9169
attn: Shiela Johnson

Roach Away
Willert Home Products
4044 Park Avenue
St. Louis, Missouri 63110
(314) 772-2822
attn: John E. Mullin

Wheat Roach Super Shot
Wheat's Roach Shot
2008 S. Central Avenue
Los Angeles, California 90006

Roach Free
Organic Distributors
P.O. Box 1367
Conroe, Texas 77305
(713) 756-6351
(713) 588-1047
attn: Sally Connelly

Wipe Out
Wilbert Products Company, Inc.
805 E. 139th Street
New York, New York 10454
(212) 292-8200
attn: Robert E. Gamber

MICROENCAPSULATED PYRETHRINS

In some locations such as underneath hot water heaters and in boiler rooms, it may be difficult to modify the habitat permanently so that the area can be kept dry. Because of the moisture, boric acid will cake and not be easily ingested or contacted by cockroaches. In such locations microencapsulated pyrethrins may afford some degree of cockroach control. The high toxicity of such substances helps counter the repellency pyrethrins have for cockroaches.

Microencapsulated pyrethrins are minute capsules made of a semi-permeable membrane containing a small quantity of synergized pyrethrin. As the insecticide on the outside of the shellwall breaks down due to exposure to air and light, more chemical diffuses through the wall to take its place. The capsules are capable of releasing small but effective doses for up to 60 days. Thus when an insect contacts and picks up the capsules (capsules cling to legs and other appendages of the cockroach's body), the insect absorbs the chemical until it dies. Tests indicate that this process takes just a few minutes. This release mechanism is important in that it reduces non-insect exposure to the synergized pyrethrin. Should capsules be ingested (by man or animal), they will pass through the body without releasing all the chemical they contain.

WHY SEEK ALTERNATIVES TO PESTICIDES?

Since 1945 pesticide use in the U.S. has increased ten-fold. Nearly a billion and a half pounds of pesticides are produced each year in the United States. Over 15% and possibly as much as a quarter of all pesticide use occurs not in agriculture but in urban and suburban areas nationwide(1).

The two major reasons to reduce unnecessary pesticide use and to seek new methods of pest control are that 1) pests are rapidly developing resistance to chemical controls, see page 3 and 4) chemical controls pose risks to human and environmental health.

Types of Pesticides

Pesticides are classified by the kind of pest they are used against and by chemical group. The most common pest-based classifications include insecticides, herbicides, fungicides and rodenticides. Large amounts of nematocides, miticides, algicides, molluscicides, repellents and plant growth regulators are also used in agriculture and in urban areas.

The major chemical classes of pesticides are:

- * organochlorines (also called chlorinated hydrocarbons)
- * organophosphates
- * carbamates
- * chlorophenoxy acid herbicides

Until the 1970's, the most commonly used pesticides were in the organochlorine class. Many of the materials now banned or heavily restricted--such as DDT, chlordane, lindane, aldrin, dieldrin and toxaphene--are in this class. They are fat soluble, bioaccumulate and persist for long periods in the environment.

Replacing the organochlorines as the most popular kind of pesticide has been the organophosphate class, called the OP's. Developed in the late 1940's, this class is widely used in agriculture and in many household products. Common OP's include malathion, parathion, diazinon and dichlorvos. The OP's do not persist in the environment, are not fat soluble and do not bioaccumulate. However, they are very acutely toxic and have caused such adverse effects as birth defects and cancer in animal tests.

Carbamates were developed in part to replace organochlorines to which certain insects had developed resistance. Common carbamates include carbaryl and propoxur. Like the OP's, they act as nerve poisons and can cause birth defects.

Chlorophenoxy acid herbicides is one of the fastest growing classes of pesticide. Common weed-killers such as 2,4-D and 2,4,5-T, widely used to kill vegetation in urban, suburban and forested areas, work by causing abnormally fast growth of stems, leaves and roots.

The controversy surrounding the possible health effects of phenoxy herbicide use, centered in the northwest United States in the heart of the

timber industry, is well known. In response to public protests and the exposure of multiple miscarriages in areas that had received aerial applications of 2,4,5-T, the U.S. Forest Service banned its use in federal forests. However, it can still be used on rice crops, grazing land, and at airports, lumberyards and in other industrial areas. 2,4-D has been accepted as a popular substitute for 2,4,5-T and is widely available in garden stores as a home weed killer.

Human Health Hazards

Acute Health Effects

Poisoning reactions can be severe and sudden (acute), less severe and longer lasting (chronic); an acute reaction may be followed by chronic symptoms. Toxic reactions to pesticides may be acute, chronic or both. Acute symptoms are those which are likely to occur within a short time after a single exposure to a pesticide. These symptoms may be minor and disappear within a short time or they may be serious, even leading to death. An acute reaction may be followed by chronic reactions. Ten years ago The World Health Organization estimated that about 500,000 people become ill each year worldwide from direct exposure to a pesticide and that about 9,200 of these cases are fatal(2). Pesticide use world-wide has increased about 50% since then. In this country, the Environmental Protection Agency (EPA) estimates that each year approximately 200 people die from pesticide poisonings(3).

California, which has the most stringent pesticide use laws in the country, reports an average of 22 pesticide-related deaths and 9,000 pesticide-related illnesses each year in the Doctor's First Report of Worker Injury (DFR) for occupational incidents and/or the Pesticide Illness Report (PIR)(4). Administration of the reporting requirements is spread among the Department of Industrial Relations (enforcing the regulation), Department of Public Health (educating health professionals about the reporting requirements), and the Department of Food and Agriculture (investigating poisoning incidents). The California Department of Health, however, has estimated that as many as 95% of all pesticide illnesses fail to be reported through this system(5).

Susceptibility Variations

Some people are more susceptible than others to the harmful effects of pesticides. Small children and the elderly may be more susceptible, as well as sick people. Developing fetuses, especially during the first three months of pregnancy, are more at risk(6). Studies on rats have shown that low protein in diets can increase the toxic effects of some pesticides(7). Race and socioeconomic status have been shown to correlate with the amount of pesticide residues found in tissue samples with levels being highest among black and lower-income groups(8,9).

In addition, certain individuals are more chemically sensitive than others. One massive exposure or a long-term low-level exposure to a pesticide may sensitize a person to the point that subsequent exposures to pesticides and other chemicals in amounts that would normally be tolerable can produce severe allergic reactions and even death(10,11).

Long-Term Health Effects

Chronic symptoms are those which appear days, weeks or even years after exposure to a pesticide. They include the following:

- * carcinogenic effects, or cancer
- * teratogenic effects, or birth defects
- * mutagenic effects, or changes in the genetic material (DNA) in the chromosomes. If the mutation occurs in a germ or reproductive cell, it could lead to a birth defect in the next generation. All carcinogens are mutagens. Most mutagens (but not all) are carcinogens.
- * neurotoxic effects, or toxic effects on the nervous system such as convulsions, mental confusion, loss of sex drive, and psychiatric disorders.

Because they do not appear at the time of exposure, chronic symptoms are often not associated with pesticides. Cancer, for instance, may appear from five to forty years after exposure to a cancer-causing substance.

The role that pesticides may play in causing long-term health effects such as cancer and birth defects is still poorly understood. One Congressional investigative subcommittee, has estimated that "at least 25% of all pesticides on the market have shown cancer-causing potential." (12)

The recent discovery of toxic waste dumps has revealed that extremely hazardous materials, including pesticides, their breakdown products, and chemicals used in their formulation, are often improperly stored and disposed of. While it is beyond our present scope to consider the extent of this threat to public health, it should be recognized that the environmental hazards of pesticides do not end with their regulation, restriction, or disposal.

Regulating the Problem

Federal

Pesticides (and other chemicals) are continuously being tested and reviewed by several Federal agencies, including the EPA. Pesticides under review by EPA undergo tests and are the subject of debates on the risks and benefits associated with their use, a process which may take years to complete.

For more information, call Paul Lapsley (703) 557-7420, or Mark Dow (703) 557-8195, at the EPA Special Review Branch. To follow the fate of pesticides, you can request that your name be placed on the list to receive updated lists of pesticides under special review. Betty Crompton at (703) 557-7436 can provide you with these lists.

Regular updates on all federal chemical (and pesticide) legislation can be found in Pesticide and Toxic Chemical News and the Chemical Regulation Reporter, both available in major libraries and in all EPA Regional libraries.

State

States often make pesticide regulations that go beyond the federal laws. California, for example, has several regulations concerning safety, record keeping, poisoning reporting, etc., that are not included in the federal law. Information about the laws and regulations in your state can be obtained from state departments of agriculture and possibly from county agricultural agents and departments of health. Keep asking until you obtain the information you need--it is your public right to know.

Footnotes

- 1 Fowler, D.L., and J.N. Mahan. 1980. The Pesticide Review, 1978. USDA, Washington, D.C.
- 2 Copplestone, J.F. 1977. A Global View of Pesticide Safety in Pesticide Management and Insecticide Resistance, D.L. Watson and A.W.A. Brown, eds. Academic Press, New York.
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- 9 Kutz, F.W., A.R. Yobs, and S.C. Strassman. September, 1977. Racial Stratification of Organochlorine Insecticide Residues in Human Adipose Tissue. Journal of Occupational Medicine, Vol. 19, No. 9, pp. 610-622.
- 10 Randolph, T.G. 1962. Human Ecology and Susceptibility to the Chemical Environment. Charles C. Thomas, publisher, Springfield, Illinois.
- 11 Wang, C.L. February, 1979. Occupational Skin Disease Continues to Plague Industry. Monthly Labor Review.

- 12 Cancer-Causing Chemicals in Food. 1979. Report Together with Separate Views by the Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce, December, 1978. U.S. Government Printing Office, Washington, D.C.

WHY POISONS ALONE AREN'T ENOUGH!

Each environment is capable of supporting a certain maximum population of any one kind of animal. This ability (called the "carrying capacity") is largely determined by the amount of food, water and living space available to the animals. The limited amounts of these necessities keeps the population from growing beyond the environment's carrying capacity.

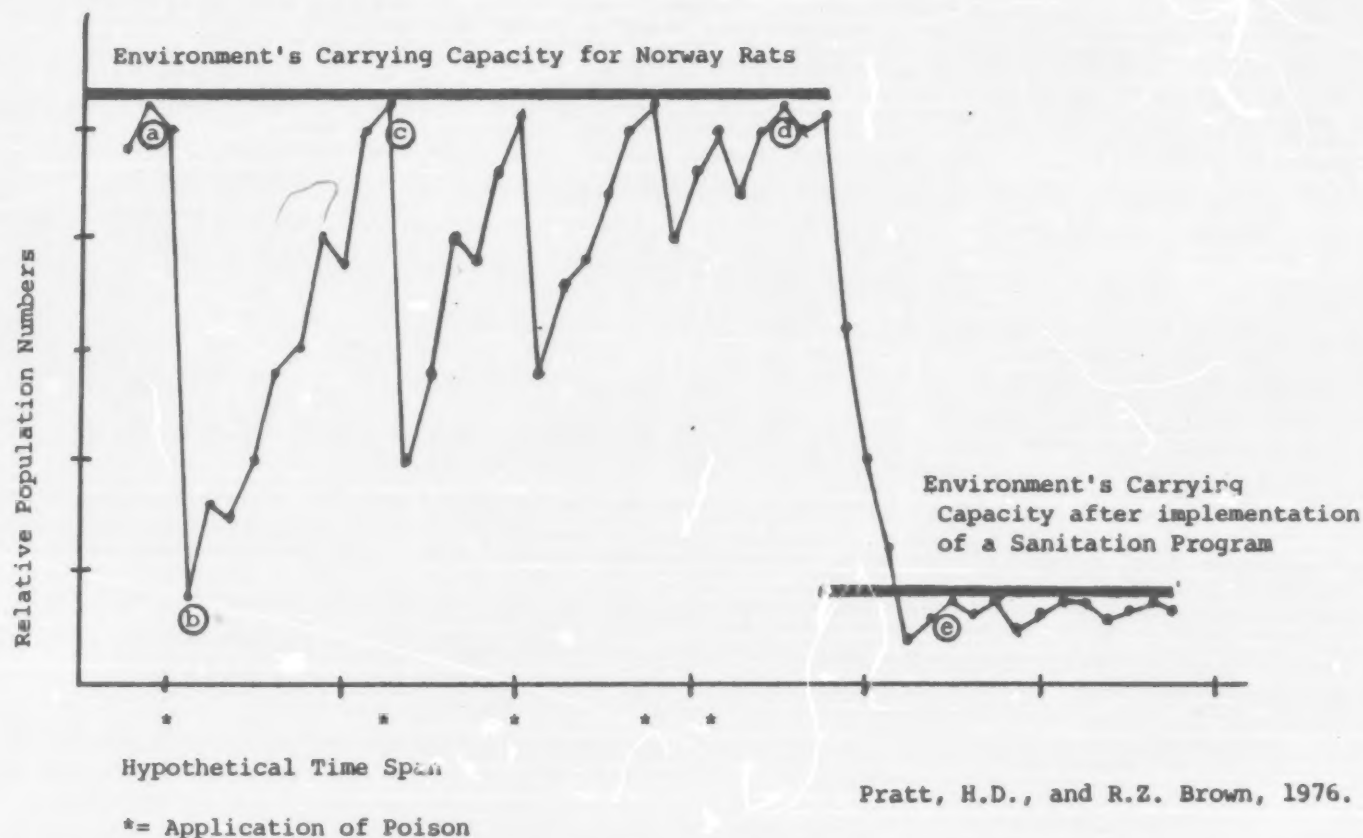
When a population (e.g., rodent) is poisoned, usually a certain percentage—but not all—of the individuals are killed. Some of the rodents survive due either to a physical factor (e.g., they didn't eat enough of the poison), or to a genetic factor (e.g., they carry one or more genetic traits which make them less susceptible to the poison). Because the surviving animals are few in number, they have little competition for the food, water and living space still available in the environment. In addition, rats may immigrate in from surrounding areas taking advantage of the reduced competition. This permits the population to grow rapidly until it once again reaches the environment's carrying capacity.

Repeated poisonings using the same toxic substance will be able to kill the offspring of the rodents that had escaped poisoning earlier because of a physical factor and those susceptible individuals that recently migrated into the area. Eventually, the rat population may consist primarily of rodents that are genetically resistant to the pesticide in use. These sometimes become known as "Super Rats." Any subsequent poisoning program will require a new poison—one that may be more toxic to humans as well as to rodents.

A more permanent solution to a pest problem requires first lowering the environment's carrying capacity by reducing available food, water and living space. If the carrying capacity is maintained at a lowered level, the pest population will not be able to grow as large as it was previously. A poisoning or trapping program initiated after the carrying capacity has been reduced will bring the population down more quickly. But it is the lowered carrying capacity that will keep it down.

References

- Ebeling, W. 1975. Urban entomology. University of California, Division of Agricultural Sciences, Berkeley, CA.
- Flint, M.L., and R. van den Bosch. 1977. A source book on Integrated Pest Management. U.S. Dept. HEW, Office of Education, Office of Environmental Education.
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Point (a) on the graph represents the initial population of Norway rats living within the environment being monitored. This number cannot exceed the environment's carrying capacity. A poison is applied resulting in a drop in the rodent population, point (b). Some individuals survive due to either a physical or a genetic factor. Since no other changes were made to the environment, these rodents reproduce until the population once again reaches the environment's carrying capacity, point (c). Repeated poisonings kill proportionately fewer and fewer of the rodents. The time needed to repopulate the environment is reduced accordingly. Eventually a population of "Super Rats" is established, point (d). A sanitation program is begun which reduces the environment's carrying capacity. The population drops with no further action and remains low, point (e).

CITATIONS

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EDUCATIONAL MATERIALS

Alternative Pest Control for City Residents	1-B
Pest Management Teaching Packets.	3-B
Pest Control in the City.	5-B
Publications Available from the John Muir Institute's Urban Pest Management Program.	7-B



Alternative Pest Control for City Residents

The John Muir Institute has developed educational materials to teach low-toxic pest control methods to city residents of all ages:

"The Cockroach Clean-Up Tour"

- * An elementary school teaching packet including lesson plans, posters, a take-home booklet, a filmstrip/cassette tape, and adequate background materials to make any teacher an "expert" on environmentally-sound pest control.



"The Case of the Wild House Mouse"

- * A smaller teaching packet also targeted for the elementary school, containing a take-home booklet, activities, and a complete bulletin board display.

"You CAN Get Rid of Mice"

"You CAN Get Rid of Cockroaches"

- * Illustrated brochures that graphically show the important steps of an IPM program.

"Selected Readings in Urban Integrated Pest Management (IPM)"

- * A collection of background materials (ranging from easy-to-understand handouts to scientific abstracts) designed to teach adult educators the basics of pest management.

"Common Sense Pest Control for the Home and the City"

- * A 58-frame slide program/tape cassette that presents the basics of an alternative pest control program. (Most effective when used along with "Selected Readings".)

"Safe Cockroach Control: A Guide to Setting Up an Integrated Pest Management Program Within a School System"

- * A comprehensive step-by-step guide to help any school administrator implement a safe and effective cockroach control program in any school system. Adequate background material is provided in addition to specific program design information. This guide could also help managers of (non-school) building complexes design an environmentally-sound program for cockroach control.



For more information on these materials, please contact:
Kathleen Letcher Cowles, John Muir Institute, 29 W. High St. (WO),
Morgantown, West Virginia 26505 (304) 296-2855

Other information on urban IPM is available from:
Urban IPM Resource Center, 1010 Grayson Street, Berkeley,
California, 94710 (415) 540-8912

PEST MANAGEMENT TEACHING PACKETS

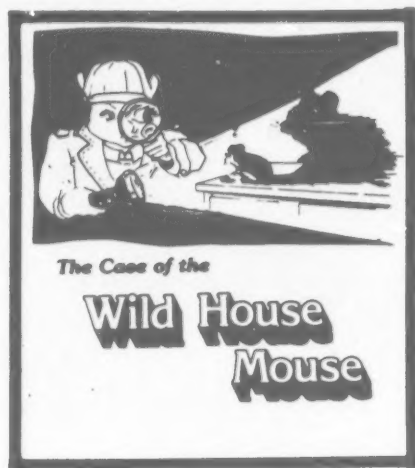
Teach your students USABLE LIFE SKILLS along with the basics!
Two elementary-level teaching packets are now available:



THE COCKROACH CLEAN-UP TOUR

Teaches the basics of safe cockroach management with humor and facts

- * 8 Complete Lesson Plans
- * Colorful Poster Set
- * Take-Home Booklets
- * Filmstrip/Cassette Tape



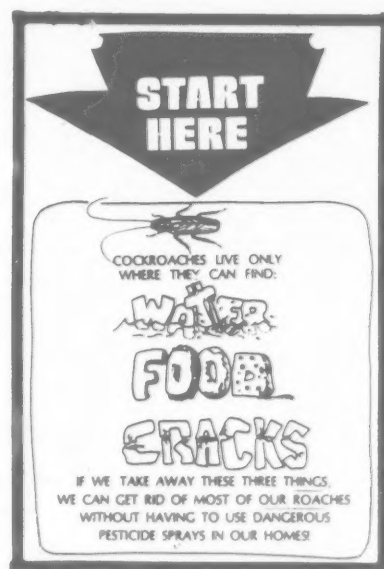
THE CASE OF THE WILD HOUSE MOUSE

Leads students to an understanding of non-toxic mouse control methods

- * Take-Home Booklets
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- * Activities

Each packet presents the basics of environmentally-sound pest management in a format that fits easily into your regular school curriculum. Adequate background materials make any teacher an "expert" on the subject.

Basic ecological concepts are described in terms of the "urban wildlife" already familiar to most students. Lessons, activities, and booklets are informative, practical---and fun!



To order teaching packets, use the enclosed order form or contact:

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PEST CONTROL IN THE CITY

New materials are available to help home/health care professionals teach the basics of safe pest control to city residents! Background readings, illustrated brochures and a slide program present effective strategies to combat urban pests.



"SELECTED READINGS IN URBAN INTEGRATED PEST MANAGEMENT"

A collection of background materials that present basic strategies to control cockroaches, rodents and head lice. Materials range from easy-to-understand handouts to scientific abstracts, providing a wide selection of education aids for the adult educator.



"COMMON SENSE PEST CONTROL FOR THE HOME AND THE CITY"

A 58-frame slide program/tape cassette that presents the basics of environmentally-sound pest control. Provides valuable background information for urban educators or community groups.



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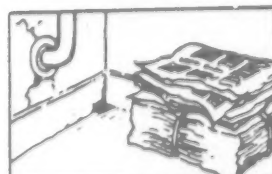
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"YOU CAN GET RID OF MICE"

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General IPM Information

\$ 11.50

Packet of articles includes Summary of Pest Control Methods, Understanding Integrated Pest Management, Pest Control Strategies: Urban Integrated Pest Management, Ecosystem Management: A Framework for Urban Pest Control, Entomophobia in the Urban Ecosystem, Options in Pest Management, and others

Controlling Cockroaches, Rodents and Head Lice

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Packet of articles includes a comicbook on cockroach control designed for apartment dwellers, reprints of articles appearing in the IPM Practitioner newsletter on roaches, rodents, and head lice, and a collection of articles on head lice management, with steps for non-toxic removal of lice

Controlling Other Common Pests

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Packet of articles includes reprints on mosquitoes, urban flies, fleas, house plant pests, termites, garden pests, and shade tree pests.

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Packet includes articles on urban ecosystem management, including Directions for Appropriate Habitat Redesigns, Model Ecosystem Management Programs, IPM for School Districts, Urban IPM Delivery Systems, and Making the Transition to an Urban IPM System.

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